SR 95 Corridor Profile Study

JUNCTION I-8 TO JUNCTION I-40

ADOT Work Task No. MPD-041-15

ADOT Contract No. DT11-013152

Kimley-Horn Project # 098236016

DRAFT

WORKING PAPER 4: PERFORMANCE-BASED NEEDS ASSESSMENT

MARCH 21, 2016

PREPARED FOR:

ARIZONA DEPARTMENT OF TRANSPORTATION

Prepared by:

Kimley»Horn

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

This report was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data, and for the use or adaptation of previously published material, presented herein. The contents do not necessarily reflect the official views or policies of the Arizona Department of Transportation or the Federal Highway Administration, U.S. Department of Transportation. This report does not constitute a standard, specification, or regulation. Trade or manufacturers' names that may appear herein are cited only because they are considered essential to the objectives of the report. The U.S. government and the State of Arizona do not endorse products or manufacturers.

LIST OF ACRONYMS AND ABBREVIATIONS

ABBREVIATION	NAME
ADOT	Arizona Department of Transportation
AZTDM	Arizona Travel Demand Model
bqAZ	Building a Quality Arizona
DMS	Dynamic Message Sign
HCRS	Highway Condition Reporting System
MP	Milepost
MPD	Multimodal Planning Division
I	Interstate
LRTP	Long-Range Transportation Plan
POE	Port of Entry
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
P2P Link	Planning to Programming Linkages
SR	State Route
TTI	Travel Time Index
TPTI	Truck Planning Time Index
TTTI	Truck Travel Time Index
V/C	Volume-to-Capacity

1 Introduction

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study of State Route 95 (SR 95) between Interstate 8 (I-8) in Yuma and Interstate 40 (I-40) north of Lake Havasu City. This study will look at key performance measures relative to the SR 95 corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

ADOT is conducting eleven Corridor Profile Studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, includes:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

The third round (Round 3) of studies, to be initiated in fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 60/US 93: Nevada State Line to SR 303L

The studies under this program will assess the overall health, or performance, of the state's strategic highways. The Corridor Profile Studies will identify candidate projects for consideration in the Multimodal Planning Division's (MPD) Planning to Programming (P2P) project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

SR 95, I-8 to I-40, depicted in Figure 1 is the subject of this Corridor Profile Study.

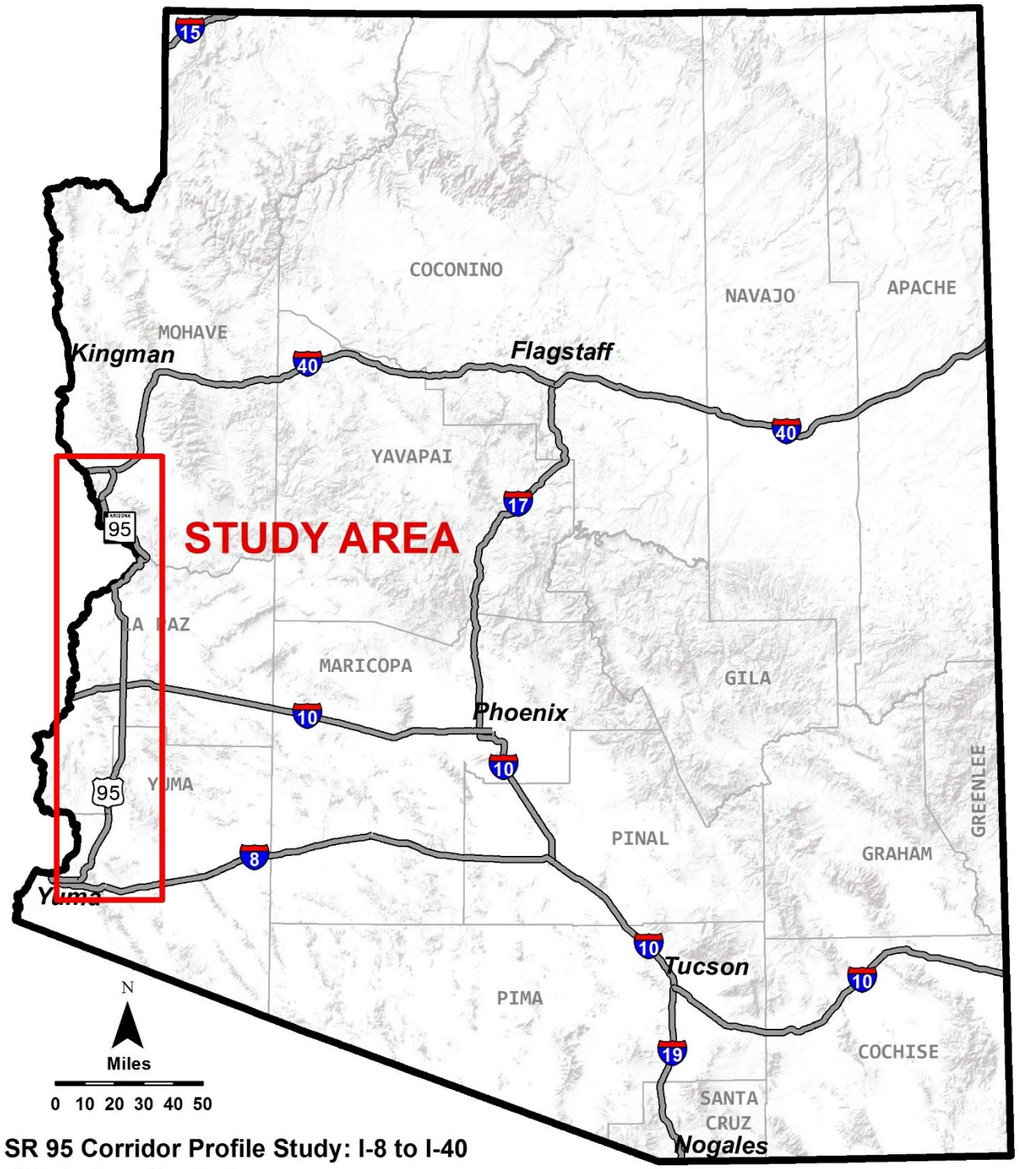


Figure 1: Corridor Study Area

1.1 Corridor Study Purpose

The purpose of the SR 95 Corridor Profile Study is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process established by the previous Round 1 corridor profile studies to:

- Inventory past improvement recommendations.
- Define corridor goals and objectives.
- Assess existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific projects that can provide quantifiable benefits in relation to the performance measures.
- Prioritize projects for future implementation.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of prioritized potential projects for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The SR 95 Corridor Profile Study will define solutions and improvements for SR 95 that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals have been identified as the desired outcome of this study:

Link project decision-making and investments on key corridors to strategic goals.

- Develop solutions that address identified corridor needs based on measured performance.
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure.

1.3 Working Paper 4 Overview

The purpose of Working Paper 4 is to document the performance-based needs for the SR 95 corridor within the study limits. Corridor needs are defined through a review of the difference in baseline corridor performance (Task 2) and the performance objectives (Task 3) for each of the five performance areas used to characterize the health of the SR 95 corridor: pavement, bridge, mobility, safety, and freight. The product of Working Paper 4 is actionable performance needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

1.4 Corridor Overview

The SR 95 corridor is a vital road link in the western part of the state, providing the only north-south link between I-8, I-10, and I-40. The US 95 portion of the SR 95 corridor runs between I-8 and I-10 and connects the cities of Yuma and Quartzsite while also providing a strategic connection to the U.S. Army Yuma Proving Ground (YPG) and General Motors Desert Proving Ground – Yuma. The SR 95 portion of the SR 95 corridor runs between I-10 and I-40 and connects the cities of Quartzsite, Parker, and Lake Havasu City. This corridor also serves and passes through the Colorado River Indian Reservation.

1.5 Study Location and Corridor Segments

The study area consists of segments of both SR 95 and US 95, however, for the purposes of this study, the study area is generally referred to as SR 95, except where noted in reference to a specific project.

The SR 95 study corridor has been divided into 13 segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. These segments are shown in Figure 2 and described in Table 1.

Table 1: SR 95 Corridor Segments

Segment Number and Name	Segment Begin/End Description	Begin Milepost	End Milepost	Length (miles)	Number of Through Lanes	2013 Average Annual Daily Traffic Volumes	Character Description
95-A	I-8 to west of Araby Road	24	29	5	4	15,353	Non-ADOT facility (turned back to City of Yuma), traffic interchange (TI) with I-8; this Segment A will not be analyzed within the SR 95 Corridor Profile Study. Segment A is identified as it is a critical connection to I-8
95-1 (Yuma)	West of Araby Road to East of Avenue 11E	29	34	5	4	11,432	Beginning-point of ADOT facility, interrupted flow facility with four-lane cross-section, relatively flat terrain, transitioning urban/rural area, junction with Araby Road and Fortuna Road, private land ownership
95-2	East of Avenue 11E to south of Imperial Dam Road	34	42	8	2	7,221	Uninterrupted flow facility with a two-lane cross-section, rolling terrain, rural, Bureau of Land Management (BLM), Bureau of Reclamation (BOR)
95-3	South of Imperial Dam Road to Yuma Proving Ground Area	42	60	18	2	3,292	Uninterrupted flow facility with two-lane cross-section, flat terrain, rural, military land ownership (Laguna Army Airfield, YPG), General Motors Desert Proving Ground Yuma, junction with Imperial Dam Road
95-4	Yuma Proving Ground Area	60	80	20	2	1,584	Uninterrupted flow facility with two-lane cross-section, relatively flat terrain, rural, BLM, Kofa National Wildlife Refuge, military land ownership
95-5	Yuma Proving Ground Area to Quartzsite Area	80	104	24	2	1,750	Uninterrupted flow facility with two-lane cross-section, flat terrain, BLM, Kofa National Wildlife Refuge
95-6 (Quartzsite)	Quartzsite Area	104	111	2.5	4	9,917	Interrupted flow with five-lane cross-section, urban area type within Quartzsite, private land ownership, BLM, State Trust land, junction with I-10, transition from US 95 to SR 95
95-7	Quartzsite Area to SR 72	111	131	20	2	2,357	Uninterrupted flow facility with two-lane cross-section, flat terrain, rural, BLM, State Trust Land
95-8	SR 72 to Parker Area	131	142	11	2	5,728	Uninterrupted flow facility with two-lane cross-section, flat, rural, BLM, State Trust land, Tribal land, junction with SR 72
95-9 (Parker)	Parker and Cienega Springs Area	142	149	7	4	12,349	Interrupted flow with five-lane cross-section, relatively flat with some grade variation, urban area type within Parker to Cienega Springs, private land ownership, Tribal land
95-10	Parker and Cienega Springs Area to Bill Williams Area	149	162	13	2	5,406	Uninterrupted flow facility with cross-sections varying from two lanes to four lanes, mountainous terrain, rural with some communities within the vicinity of the corridor, State Trust land
95-11	Bill Williams River to Lake Havasu City Area	162	176	14	2	5,127	Uninterrupted flow facility with two-lane cross-section, mountainous terrain, rural, BLM, U.S. Fish and Wildlife Service, State Trust land
95-12 (Lake Havasu City)	Lake Havasu City Area	176	190	14	4	17,771	Interrupted flow facility with five-lane cross-section, flat terrain, urban area type within Lake Havasu City and Desert Hills, private land ownership, State Trust land
95-13	Lake Havasu City Area to I-40	190	202	12	2	7,886	Uninterrupted flow facility with cross-sections varying from two lanes to four lanes, rolling hills terrain, rural, BLM, junction with I-40

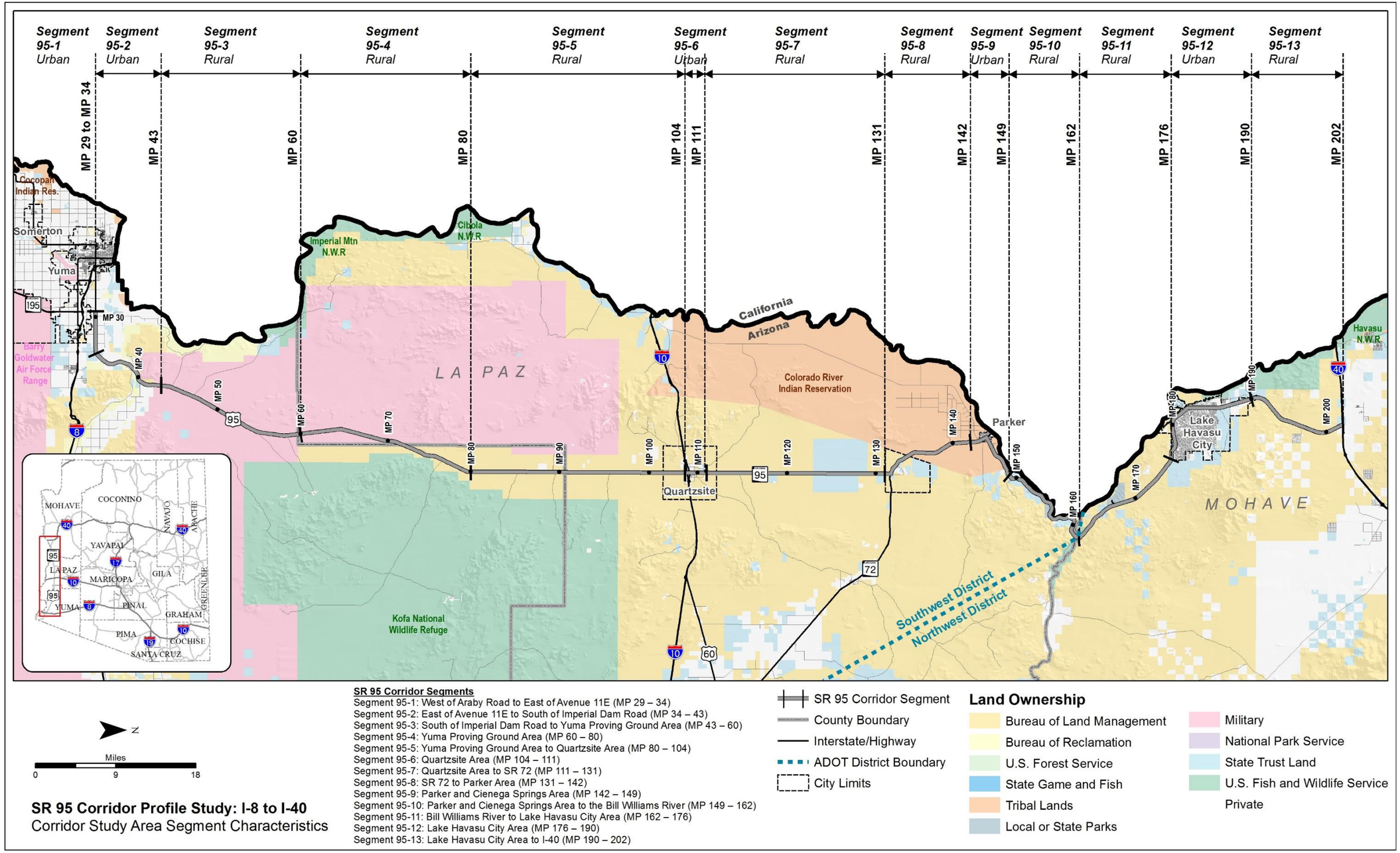


Figure 2: Location Map and Corridor Segments

2 Needs Assessment Process

The performance-based needs assessment will determine the difference in baseline performance (Working Paper #2) and the performance objectives (Working Paper #3) for each of the five performance areas used to characterize the health of the corridor: pavement, bridge, mobility, safety, and freight. The following guiding principles were developed as an initial step in process development.

- Corridor needs should be defined as deficiencies in performance
- The needs assessment process should be systematic, progressive, and repeatable
- The process should consider all primary and secondary performance measures developed in Task 2 of the study
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by milepost limits)
- The process should generally be automated but include engineering judgment where needed
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

The performance-based needs assessment process is illustrated in Figure 3 and described in the following sections of the working paper.

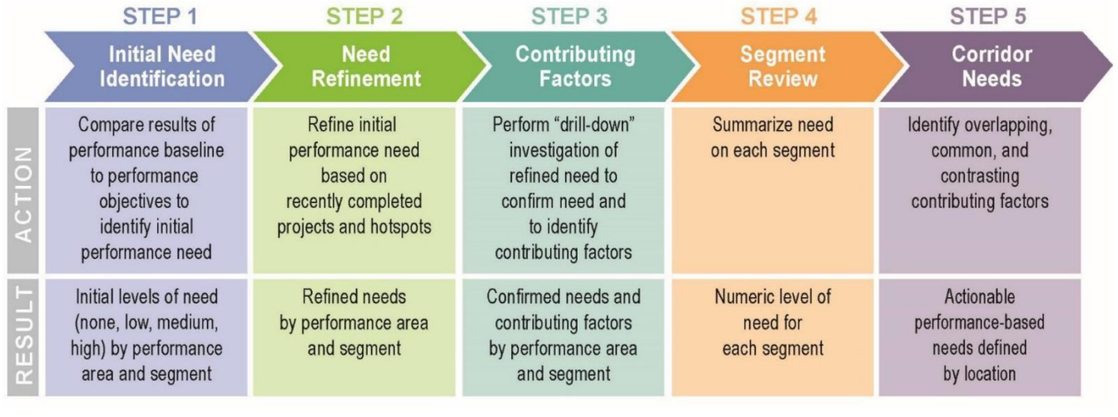


Figure 3: Needs Assessment Process

2.1 Step 1: Initial Needs Identification

The first step in the needs assessment process links baseline (existing) corridor performance documented in Working Paper 2 with performance objectives documented in Working Paper 3. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of initial performance needs. This mathematical comparison results in an initial needs rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process is shown in Figure 4.

Performance Thresholds	Performance Level	Initial Level of Need	Description
3.75	Good	None	All levels of Good and top 1/3 of Fair (>3.57)
	Good		
	Good		
	Fair		
	Fair	Low	Middle 1/3 of Fair (3.38-3.57)
3.20	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (3.02-3.38)
	Poor		
	Poor	High	Lower 2/3 of Poor (<3.02)
	Poor		

Figure 4: Initial Needs Ratings in Relation to Baseline Performance

Initial levels of needs for each performance measure are combined to produce a weighted initial deficiency rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial deficiency levels of None, Low, Medium, and High, respectively. A weight of 1.0 is applied to the need for the Performance Index primary performance measure and equal weights of 0.20 are applied to each deficiency for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10. The secondary performance measure deficiencies are added to the deficiency from the Primary Index to create a cumulative measure of deficiency. The resulting weighted initial level of Need is assigned a level of None, Low, Medium, or High. With this approach, the resulting segment level of need will always be equal to or higher than the Primary Index deficiency.

2.2 Step 2: Final Needs

In Step 2, the initial level of needs for each segment is refined using the following information and engineering judgment.

- The existence (or frequency) of hot spots in the segment could be justification for increasing the level of deficiency.
- Maintenance history or the level of past investments could be justification for changing the level of need.
- Recently completed projects or projects under construction may be justification for changing the level of, or eliminating, a need.
- Findings from previous studies such as the ADOT Climbing and Passing Lane Prioritization Study (2015) and ADOT staff input can provide additional information regarding a need that has been identified but should not be used to change the level of deficiency.
- While informative as potential solutions to address needs, programmed projects should not be used to change the level of need because programmed projects may not be implemented as planned due to factors such as changes in scope during project development or changes in funding availability or priority. Programmed projects were identified using the tentative *2016-2020 Current Five-Year Transportation Facilities Construction Program* and approved *2015-2019 State Transportation Improvement Program*.

The resulting refined needs (potential increase, decrease, or no change from initial needs will be carried forward for further evaluation in Step 3.

2.3 Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to confirm the refined needs and identify contributing factors for the deficiency. Typically, the same databases that are used to develop the baseline performance serve as the principle sources for detailed diagnostic analysis. However, other supplemental databases may be useful sources of information. The databases used for diagnostic analysis are listed below.

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- Bridge Information and Storage System

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- Arizona Travel Demand Model (AZTDM)
- HERE Travel Time Database
- Highway Condition Reporting System (HCRS) Closure Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources were considered to help identify the contributing factors such as:

- Maintenance history, the level of past investments, or trends in historical data were used to help provide context for pavement and bridge history.
- Field observations from ADOT district personnel could be used to provide additional information regarding a need that has been identified.
- Previous studies were used to provide additional information regarding a need that has been identified.

Step 3 results in the identification of performance-based deficiencies and contributing factors by segment (and milepost locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance.

2.4 Step 4: Segment Review

In this step, the deficiencies from Step 3 will be quantified for each segment to numerically estimate the level of deficiency for each segment. Values of 0, 1, 2, and 3 are assigned to the final deficiency levels (from Step 3) of None, Low, Medium, and High, respectively. A weight of 1.5 is applied to the performance areas that were identified as Emphasis Areas for each corridor in Working Paper 3 and a weighted average deficiency is calculated for each segment. The resulting level of need value can be used to compare across corridors and to determine the location of the highest level of need on a given corridor.

2.5 Step 5: Corridor Needs

In Step 5, performance-based needs and contributing factors are transformed into actionable corridor needs. Level of needs and contributing factors for each performance area are reviewed on a segment-by-segment basis to identify overlapping, common, and contrasting needs to facilitate the formation of solution sets to improve corridor performance.

3 Pavement Performance Area Needs (Steps 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the SR 95 corridor for the Pavement Performance Area. The methodology for performing Steps 1 through 3 is provided in the **Appendix**.

3.1 Step 1: Initial Pavement Needs

Step 1 uses the Pavement Index and two secondary performance measures (Directional PSR and Percent Pavement Failure) that were documented in Working Paper #2 to establish the baseline performance data. The baseline performance data and performance objectives (Working Paper #3) for the SR 95 corridor were used to determine the Initial Needs as described in Section 2.1. The pavement condition data used to calculate baseline performance was provided by ADOT for the timeframe from 2012 to 2013. The results of Step 1 are shown in Table 2.

Table 2: Initial Pavement Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							NB	SB		NB	SB				
95-1	5	29-34	Highway	3.54	Fair or Better	None	3.64	3.64	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-2	9	34-43	Highway	3.86	Fair or Better	None	3.78	3.78	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-3	17	43-60	Highway	3.63	Fair or Better	None	3.51	3.51	Fair or Better	None	None	35.29%	Fair or Better	High	Low
95-4	20	60-80	Highway	4.41	Fair or Better	None	4.28	4.28	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-5	24	80-104	Highway	4.14	Fair or Better	None	4.12	4.12	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-6	2.5	104-111	Highway	3.27	Fair or Better	Low	3.23	3.23	Fair or Better	Low	Low	33.33%	Fair or Better	High	Medium
95-7	20	111-131	Highway	3.69	Fair or Better	None	3.76	3.76	Fair or Better	None	None	5.00%	Fair or Better	None	None
95-8	11	131-142	Highway	3.49	Fair or Better	None	3.27	3.27	Fair or Better	Low	Low	9.09%	Fair or Better	None	Low
95-9	6	142-149	Highway	3.59	Fair or Better	None	3.84	3.84	Fair or Better	None	None	14.29%	Fair or Better	Low	Low
95-10	14	149-162	Highway	3.66	Fair or Better	None	3.59	3.59	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-11	14	162-176	Highway	4.13	Fair or Better	None	4.13	4.13	Fair or Better	None	None	0.00%	Fair or Better	None	None
95-12	14	176-190	Highway	3.77	Fair or Better	None	3.51	4.15	Fair or Better	None	None	14.29%	Fair or Better	Low	Low
95-13	12	190-202	Highway	2.77	Fair or Better	Medium	3.77	3.77	Fair or Better	None	None	24.69%	Fair or Better	Medium	Medium
Emphasis Area?	No	Weighted Average		3.79	Fair or Better	None									

3.2 Step 2: Final Pavement Needs

The Initial Needs for the SR 95 corridor were refined as described in Section 2.2. The locations of pavement failure hot spots and recent projects that would supersede the condition data were used to refine the Needs. A summary of this process is shown in Table 3.

Pavement Hot Spots

The locations of pavement failure (hot spots) are listed in Table 3. If an Initial Need was not identified in Step 1, the existence of hot spots would be justification for increasing the Need from None to Low in Step 2.

Previous Projects

Previous projects which would supersede the pavement conditions data are listed in Table 3. In Step 2, this information was used to lower or eliminate Needs on segments where recent paving projects have been completed.

Table 3 also includes information on pavement-related programmed projects. While programmed projects did not influence the level of Need, they were documented for future reference during the development of solutions to address identified Needs. Programmed projects were identified using the 2016-2020 Five-Year Transportation Facilities Construction Program.

3.3 Step 3: Pavement Contributing Factors

The Final Needs for the SR 95 corridor were further investigated as described in Section 2.3. ADOT provided pavement rehabilitation project data for the last 20 years which was used to estimate the level of historical investment in each segment and is summarized in Figure 5.

In addition, PeCOS data was collected for each segment to estimate the level of pavement maintenance activity. If the PeCOS data showed a high level of maintenance investment, the overall historical investment was elevated by one (from “Medium” to “High”, for example). Additional information regarding the determination of the level of historical investment is contained in the Appendix.

For the Pavement Performance Area, no additional data is readily available so the contributing factors simply identify the specific locations of Needs, the level of historical investment, and any additional supporting information available from the ADOT Districts. A summary of this process is shown in Table 4.

Table 3: Final Pavement Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments		Final Need	Comments (may include programmed projects or issues from previous reports)
				Hot Spots	Previous Projects (which supersede condition data)		
95-1	5	29-34	None			None	
95-2	9	34-43	None			None	
95-3	17	43-60	Low	MP 46-47, 48-51, and 52-54	- According to the Southwest district, recent chip seal project should have addressed hot spots within MP 44 - 54 (2009). - Pavement preservation project at MP 54 - 63 (2013) - Fog seal project at MP 54 - 63 (2015	None	
95-4	20	60-80	None		A recent fog seal was performed at MP 63 - 80 (2016)	None	
95-5	24	80-104	None			None	A fog seal project is expected to begin in 2016, MP 80 - 104.
95-6	2.5	104-111	Medium	MP 104-105	A micro/slurry seal was recently performed within MP 104-111 where some cracking was observed (2015)	Low	With the recent projects performed, the Southwest district recommends lowering the level of need to a "Low".
95-7	20	111-131	None	MP 120-121		None	A chip-sealing project was requested by the Yuma District at MP 116 - 132
95-8	11	131-142	Low	MP 131-132	Fog seal project in process (2016), MP 142 - 161	Low	No programmed projects to address failure hot spots
95-9	6	142-149	Low	MP 148-149	Fog seal project in process (2016), MP 142 - 161	Low	No programmed projects to address failure hot spots
95-10	14	149-162	None		Fog seal project in process (2016), MP 142 - 161	None	The Southwest district suggested that this segment has a "Medium" level of need. However, the 2015 data doesn't exhibit any pavement hot spots.
95-11	14	162-176	None			None	
95-12	14	176-190	Low	MP 181-183		Low	- A roadway depression has been observed by the district approximately at MP 180/182 in the southbound direction, south of Mulberry - The Southwest district recommends a pavement preservation project from Lake Drive (MP 187) to the beginning of Segment 12 (MP176).
95-13	12	190-202	Medium	MP 191-194	Passing Lane at MP 190 - 195 (NB)	None	- Repaving as part of the construction of the Passing Lane has been observed to address the pavement deficiencies. - Pavement hot spot observed by the Northwest district around the I-40 interchange.

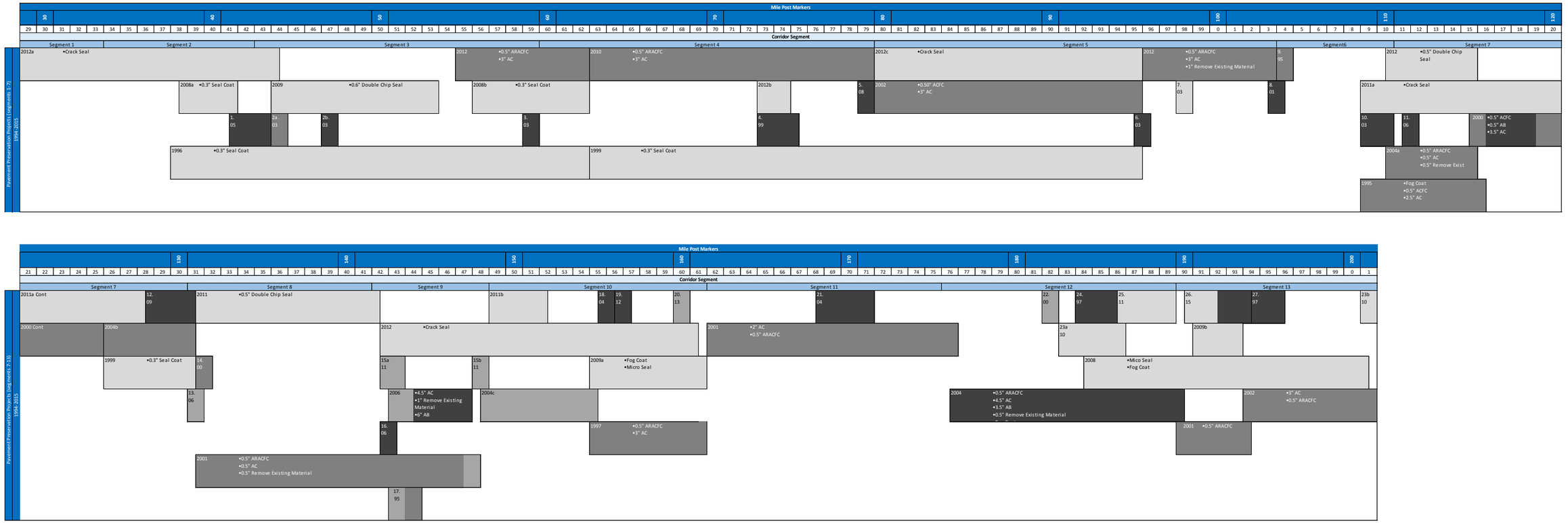


Figure 5: Pavement History

Table 4: Pavement Needs Contributing Factors (Step 3)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Historical Investment	Contributing Factors and Comments
95-1	5	29-34	None	Low	No contributing factors identified
95-2	9	34-43	None	Medium	No contributing factors identified
95-3	17	43-60	None	Low	Multiple projects lowered the level of need to “None”
95-4	20	60-80	None	Medium	No contributing factors identified
95-5	24	80-104	None	Medium	No contributing factors identified
95-6	2.5	104-111	Low	Low	Recent projects and feedback from the Southwest district drops the level of need from a “Medium” to “Low
95-7	20	111-131	None	High	No contributing factors identified
95-8	11	131-142	Low	Medium	No contributing factors identified
95-9	6	142-149	Low	High	No contributing factors identified
95-10	14	149-162	None	Medium	No contributing factors identified
95-11	14	162-176	None	Medium	No contributing factors identified
95-12	14	176-190	Low	High	A pavement preservation project recommended by the Northwest district (MP 187 – 176)
95-13	12	190-202	None	High	Passing lane construction within the hot spot addressed the pavement issues

4 Bridge Performance Area Needs (Steps 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the SR 95 corridor for the Bridge Performance Area. The methodology for performing Steps 1 through 3 is provided in the Appendix.

4.1 Step 1: Initial Bridge Needs

Step 1 uses the Bridge Index and three secondary performance measures (Bridge Rating, Bridge Sufficiency, and Percent Functionally Obsolete Bridges) that were documented in Working Paper #2 to establish the baseline performance data. The baseline performance data and performance objectives (Working Paper #3) for the SR 95 corridor were used to determine the Needs as described in Section 2.1. The bridge condition data used to calculate baseline performance was provided by ADOT for the timeframe from 2012 to 2014. The results of Step 1 are shown in Table 5.

Table 5: Initial Bridge Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
1	5	29-34	1	6.00	Fair or Better	None	6	Fair or Better	None	80.9	Fair or Better	None	0.0%	Fair or Better	None	None
2	9	34-43	2	6.00	Fair or Better	None	6	Fair or Better	None	78.1	Fair or Better	None	8.5%	Fair or Better	None	None
3	17	43-60	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	68.2	Fair or Better	Low	0.0%	Fair or Better	None	Medium
4	20	60-80	0	No Bridges within Segment												
5	24	80-104	0	No Bridges within Segment												
6	2.5	104-111	1	6.00	Fair or Better	None	6	Fair or Better	None	76.0	Fair or Better	None	0.0%	Fair or Better	None	None
7	20	111-131	1	6.00	Fair or Better	None	6	Fair or Better	None	79.0	Fair or Better	None	0.0%	Fair or Better	None	None
8	11	131-142	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	67.0	Fair or Better	Low	0.0%	Fair or Better	None	Medium
9	6	142-149	2	6.76	Fair or Better	None	6	Fair or Better	None	80.9	Fair or Better	None	0.0%	Fair or Better	None	None
10	14	149-162	2	6.25	Fair or Better	None	6	Fair or Better	None	78.3	Fair or Better	None	0.0%	Fair or Better	None	None
11	14	162-176	0	No Bridges within Segment												
12	14	176-190	3	5.46	Fair or Better	Medium	5	Fair or Better	Low	76.8	Fair or Better	None	20.2%	Fair or Better	None	Medium
13	12	190-202	0	No Bridges within Segment												
Emphasis Area?	No	Weighted Average		5.72	Fair or Better	Low										

4.2 Step 2: Final Bridge Needs

The Initial Needs for the SR 95 corridor were refined as described in Section 2.2. The locations of bridge failure hot spots and recent projects that would supersede the condition data were used to refine the Needs. A summary of this process is shown in Table 6.

Bridge Hot Spots

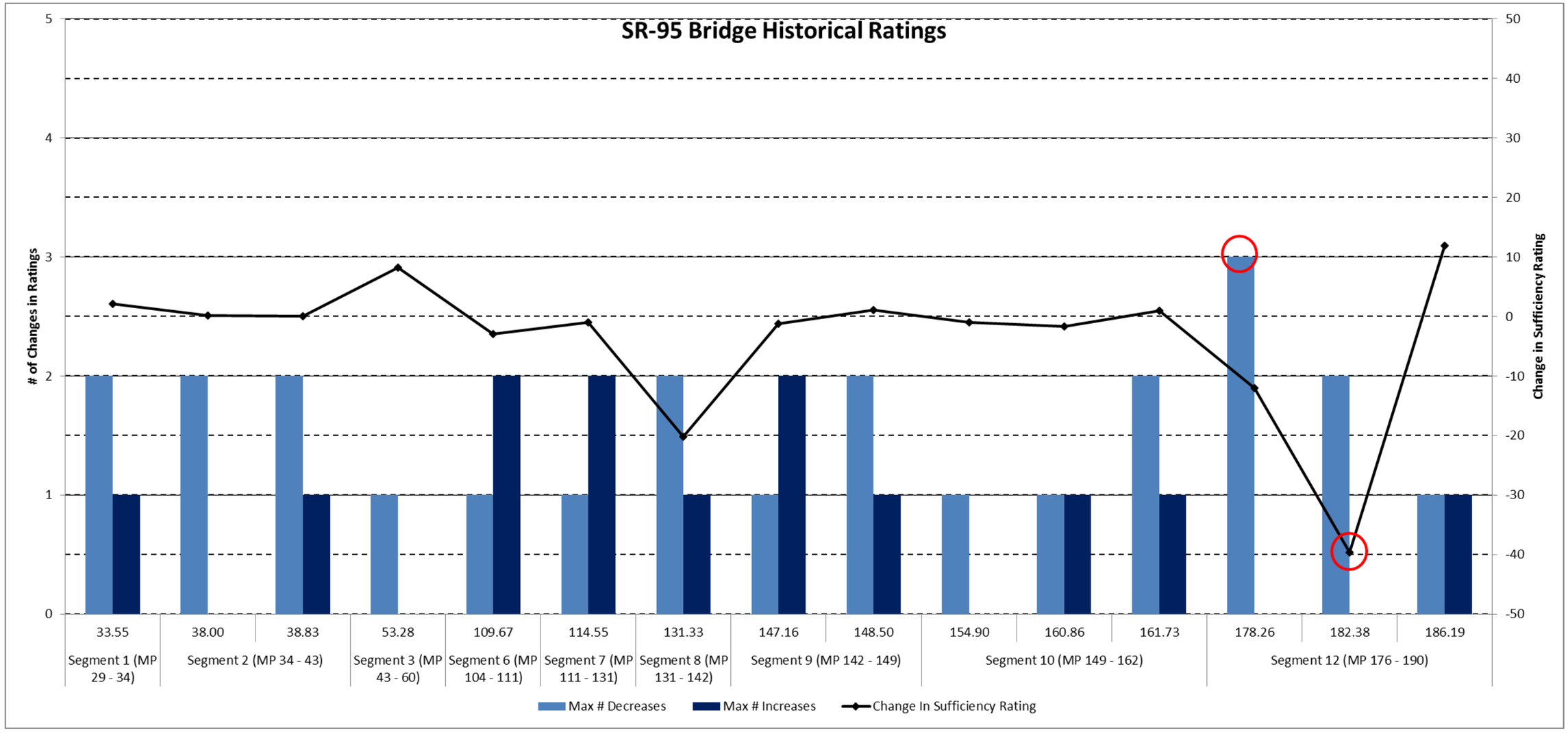
The locations of bridges with a single rating of 4 or less, or multiple ratings of 5 (hot spots) are listed in Table 6. If an Initial Need was not identified in Step 1, the existence of hot spots would be justification for increasing the Need from None to Low in Step 2.

Previous Projects

Previous projects which would supersede the bridge condition data are listed in Table 6. In Step 2, this information was used to lower or eliminate Needs on segments where recent rehabilitation projects have been completed.

ADOT provided historical bridge rating data for the last 17 years which was used to investigate historical trends for each bridge and is summarized in Figure 6. Bridges that were identified with possible historical concerns are identified in Table 6. The number of functionally obsolete bridges is also shown in Table 6. While historical concerns and functional obsolescence were not used to adjust the level of Need, they were listed in Table 6 as input to the identification of contributing factors.

Table 6 also includes information on bridge-related programmed projects. While programmed projects did not influence the level of Need, they were documented for future reference during the development of solutions to address identified Needs. Programmed projects were identified using the 2016-2020 Five-Year Transportation Facilities Construction Program.



Maximum # Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014.
(a higher number could indicate a more dramatic decline in the performance of the bridge)
Maximum # Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014.
(a higher number could indicate a higher level of investment)
Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014.
(a bigger negative number could indicate a more dramatic decline in the performance of the bridge)

Figure 6: Bridge History

Table 6: Final Bridge Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
1	5	29-34	1	None		None	None			
2	9	34-43	2	None		None	None		1	*Programmed:* Fortuna Wash Bridge at MP 34 (2016 construction underway) Wellton Mohawk Canal Bridge was identified as Functionally Obsolete
3	17	43-60	1	Medium		None	Medium			
4	20	60-80	0	None		None	None			
5	24	80-104	0	None		None	None			
6	2.5	104-111	1	None		None	None			
7	20	111-131	1	None		None	None			
8	11	131-142	1	Medium	Bouse Wash Bridge (#1321)(MP 131.33)	None	Medium	1 Bridge (Bouse Wash Bridge)		Bouse Wash Bridge has a rating of 4 or multiple 5's
9	6	142-149	2	None		None	None			
10	14	149-162	2	None		None	None			
11	14	162-176	0	None		None	None			
12	14	176-190	3	Medium	Mockingbird Wash Bridge (#1915)(MP 178.26)	None	Medium	2 bridges (Mockingbird Wash Bridge and McCulloch Blvd UP)	1	- Mockingbird Wash Bridge has a rating of 4 or multiple 5's and was identified in the historical review - McCulloch Blvd UP was identified in the historical review - The Northwest district recognized Falls Springs Wash Bridge (#2265) at MP 186.2 having settlement issues that are not described in the recent bridge inspection ratings
13	12	190-202	0	None		None	None			

4.3 Step 3: Bridge Contributing Factors

The Final Needs for the SR 95 corridor were further investigated as described in Section 2.3. The current bridge ratings were reviewed to determine which rating (or ratings) were less than 6 (Deck, Superstructure, Substructure, or Structural Evaluation Rating). Table 7 provides a summary of this information along and also identifies the bridges with potential historical concerns, and provides any additional information related to the contributing factors.

Table 7: Bridge Contributing Factors (Step 3)

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
1	5	29-34	1	0	None	No bridges with current ratings less than 6 and no historical issues			
2	9	34-43	2	1	None	No bridges with current ratings less than 6 and no historical issues			
3	17	43-60	1	0	Medium	Castle Dome Wash Br (#583)(MP 53.28)	Current Evaluation Rating of 5	This structure was not identified in historical review	
4	20	60-80	0	0	None	**No bridges within segment**			
5	24	80-104	0	0	None	**No bridges within segment**			
6	2.5	104-111	1	0	None	No bridges with current ratings less than 6 and no historical issues			
7	20	111-131	1	0	None	No bridges with current ratings less than 6 and no historical issues			
8	11	131-142	1	0	Medium	Bouse Wash Bridge (#1321)(MP 131.33)	Current Deck and Substructure Rating of 5	Identified through the Historical Review	Could have a repetitive investment issue
9	6	142-149	2	0	None	No bridges with current ratings less than 6 and no historical issues			
10	14	149-162	2	0	None	No bridges with current ratings less than 6 and no historical issues			
11	14	162-176	0	0	None	**No bridges within segment**			
12	14	176-190	3	1	Medium	Mockingbird Wash Br (#1915)(MP 178.26)	Current Deck and Substructure Rating of 5	Identified through the Historical Review	Could have a repetitive investment issue
						McCulloch Blvd UP (#1824)(MP 182.38)	Current deck rating of 5	Identified through the Historical Review	- Could have a repetitive investment issue - The district recommends that Falls Spring Wash Bridge be considered as a bridge hot spot
13	12	190-202	0	0	None	**No bridges within segment**			

5 Mobility Performance Area Needs

The following sections describe the first three steps of the five-step needs assessment process described in Section 2 for the SR 95 corridor for the Mobility Performance Area. The detailed methodology for performing Steps 1-3 is provided in the Appendix.

5.1 Step 1: Initial Mobility Needs

The baseline performance scores (from Working Paper #2) and performance objectives (from Working Paper #3) for the SR 95 corridor were used to determine the initial mobility needs, as described in Section 2.1.

Step 1 uses the scores for the Mobility Index primary performance measure and six secondary performance measures to determine the level of need for each performance measure by segment. The six secondary performance measures are Future Daily Volume-to-Capacity (V/C), Existing Directional Peak Hour V/C, Directional Closure Extent, Directional Travel Time Index (TTI), Directional Planning Time Index (PTI), and Bicycle Accommodation. The mobility condition data used to calculate baseline performance was provided by ADOT for 2014 for the existing traffic volumes and travel time data, 2014 for bicycle accommodation data, 2035 for future traffic volumes, and 2010-2014 for the closure data. The performance scores, objectives and initial levels of need for each mobility performance measure and for all mobility performance measures combined are shown in Table 8 and Table 9.

The initial need for all mobility performance measures combined represents a weighted sum of individual mobility performance measure levels of need. The initial need for a given segment may subsequently be modified (in Step 2) based on relevant recently completed or under-construction projects that have or will improve mobility performance compared to the baseline performance condition.

Segments 13 reports a high level of need in the southbound Travel Time Index. The Planning Time Index reports seven segments with a high level of need, especially for the northbound direction. According to the Bicycle Accommodation measure, there is an apparent high level of need to accommodate non-motorized travelers throughout the corridor.

Table 8: Initial Mobility Needs (Step 1)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											NB	SB		NB	SB	NB	SB		NB	SB
1	29-34	5	Urban	Interrupted	0.35	Fair or Better	None	0.41	Fair or Better	None	0.30	0.29	Fair or Better	None	None	0.37	0.12	Fair or Better	Low	None
2	34-43	9	Rural	Uninterrupted	0.43	Fair or Better	None	0.50	Fair or Better	None	0.41	0.41	Fair or Better	None	None	0.16	0.02	Fair or Better	None	None
3	43-60	17	Rural	Uninterrupted	0.09	Fair or Better	None	0.11	Fair or Better	None	0.12	0.11	Fair or Better	None	None	0.07	0.00	Fair or Better	None	None
4	60-80	20	Rural	Uninterrupted	0.13	Fair or Better	None	0.15	Fair or Better	None	0.17	0.17	Fair or Better	None	None	0.03	0.01	Fair or Better	None	None
5	80-104	24	Rural	Uninterrupted	0.11	Fair or Better	None	0.12	Fair or Better	None	0.14	0.14	Fair or Better	None	None	0.01	0.06	Fair or Better	None	None
6	104-111	2.5	Urban	Interrupted	0.14	Fair or Better	None	0.17	Fair or Better	None	0.15	0.15	Fair or Better	None	None	0.00	0.08	Fair or Better	None	None
7	111-131	20	Rural	Uninterrupted	0.22	Fair or Better	None	0.29	Fair or Better	None	0.24	0.25	Fair or Better	None	None	0.37	0.08	Fair or Better	Low	None
8	131-142	11	Rural	Uninterrupted	0.47	Fair or Better	None	0.61	Fair or Better	None	0.36	0.36	Fair or Better	None	None	0.04	0.27	Fair or Better	None	None
9	142-149	6	Urban	Interrupted	0.32	Fair or Better	None	0.35	Fair or Better	None	0.32	0.36	Fair or Better	None	None	0.51	0.03	Fair or Better	Medium	None
10	149-162	14	Rural	Uninterrupted	0.37	Fair or Better	None	0.40	Fair or Better	None	0.33	0.33	Fair or Better	None	None	0.18	0.16	Fair or Better	None	None
11	162-176	14	Rural	Uninterrupted	0.27	Fair or Better	None	0.30	Fair or Better	None	0.24	0.23	Fair or Better	None	None	0.17	0.29	Fair or Better	None	None
12	176-190	14	Urban	Interrupted	0.65	Fair or Better	None	0.83	Fair or Better	Low	0.42	0.40	Fair or Better	None	None	0.46	0.09	Fair or Better	Low	None
13	190-202	12	Rural	Uninterrupted	0.37	Fair or Better	None	0.42	Fair or Better	None	0.29	0.28	Fair or Better	None	None	0.15	0.13	Fair or Better	None	None
Mobility Emphasis Area		Yes	Weighted Average		0.28	Good	None													

Table 9: Initial Mobility Needs (Step 1)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional TTI (all vehicles)					Directional PTI (all vehicles)					Bicycle Accommodation			Initial Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					NB	SB		NB	SB	NB	SB		NB	SB				
1	29-34	5	Urban	Interrupted	1.08	1.15	Fair or Better	None	None	2.96	3.90	Fair or Better	None	None	62%	Fair or Better	Medium	Low
2	34-43	9	Rural	Uninterrupted	1.05	1.00	Fair or Better	None	None	2.21	1.14	Fair or Better	High	None	56%	Fair or Better	Medium	Low
3	43-60	17	Rural	Uninterrupted	1.02	1.00	Fair or Better	None	None	1.19	1.16	Fair or Better	None	None	8%	Fair or Better	High	Low
4	60-80	20	Rural	Uninterrupted	1.19	1.04	Fair or Better	None	None	5.36	1.40	Fair or Better	High	Low	0%	Fair or Better	High	Low
5	80-104	24	Rural	Uninterrupted	1.00	1.06	Fair or Better	None	None	1.13	1.55	Fair or Better	None	Medium	2%	Fair or Better	High	Low
6	104-111	2.5	Urban	Interrupted	1.48	1.31	Fair or Better	None	None	7.75	5.42	Fair or Better	High	Medium	87%	Fair or Better	None	Low
7	111-131	20	Rural	Uninterrupted	1.06	1.04	Fair or Better	None	None	1.32	1.43	Fair or Better	None	Low	0%	Fair or Better	High	Low
8	131-142	11	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.71	1.37	Fair or Better	High	Low	25%	Fair or Better	High	Low
9	142-149	6	Urban	Interrupted	1.31	1.29	Fair or Better	None	None	7.35	4.58	Fair or Better	High	Low	61%	Fair or Better	Medium	Low
10	149-162	14	Rural	Uninterrupted	1.06	1.00	Fair or Better	None	None	1.28	1.15	Fair or Better	None	None	2%	Fair or Better	High	Low
11	162-176	14	Rural	Uninterrupted	1.08	1.05	Fair or Better	None	None	1.36	1.61	Fair or Better	None	High	0%	Fair or Better	High	Low
12	176-190	14	Urban	Interrupted	1.24	1.20	Fair or Better	None	None	4.71	3.78	Fair or Better	Low	None	9%	Fair or Better	High	Low
13	190-202	12	Rural	Uninterrupted	1.06	2.01	Fair or Better	None	High	3.95	7.29	Fair or Better	High	High	71%	Fair or Better	Low	Low

5.2 Step 2: Final Mobility Needs

Once the initial mobility needs by segment for the SR 95 corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in Table 10.

Recently Completed and Under-Construction Mobility Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a mobility need on a corridor segment. If a recently completed or under-construction project has a high likelihood to improve or address a performance need, the level of need for that segment was decreased.

Planned or Programmed Projects

Information was noted on mobility-related planned and programmed projects was identified through the ADOT Five-Year Facilities Construction Program and other studies identified in Working Paper #1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 10: Final Mobility Needs (Step 2)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments	Final Need	Planned and Programmed Future Projects
				Recent Projects Since 2014		
1	29-34	5	Low	None	Low	Programmed: H838801C, Construct Traffic Signal at SR 95 / Avenue 8E at MP 31 (2016-2020 STIP), FY 2017 Additional future planned projects or recommendations include: Final DCR (2007) for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane
2	34-43	9	Low	None	Low	Programmed: Fortuna Wash Bridge at MP 34 (2016 construction underway) Additional future planned projects or recommendations include: Final DCR (2007) for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane
3	43-60	17	Low	None	Low	Additional future planned projects or recommendations include: Final DCR (2007) for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane Final DCR (2012) for US 95 (MP 42 to Cibola Lake Road); Widen to four lanes
4	60-80	20	Low	None	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 76 - 82 (NB/SB) - Tier 3 Low Priority Final DCR (2012) for US 95 (MP 42 to Cibola Lake Road); Widen to four lanes
5	80-104	24	Low	None	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 88 - 90 (NB) - Tier 3 Low Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 92 - 98 (NB/SB) - Tier 3 Low Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 84 - 90 (SB) - Tier 3 Low Priority
6	104-111	2.5	Low	None	Low	
7	111-131	20	Low	None	Low	

Table 10: Final Mobility Needs (Step 2) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments	Final Need	Planned and Programmed Future Projects
				Recent Projects Since 2014		
8	131-142	11	Low	None	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 132 - 139 (NB/SB) - Tier 2 Medium Priority
9	142-149	6	Low	None	Low	*Programmed: H848901D,* Construct Traffic Signal at SR 95 and Mohave Road at MP 142.9 (2016-2020 STIP), FY 2017
10	149-162	14	Low	None	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 158 - 161 (NB) - Tier 2 Medium Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 152 - 155 (NB) - Tier 3 Low Priority
11	162-176	14	Low	None	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 166 - 175 (SB) - Tier 2 Medium Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 166 - 173 (NB) - Tier 3 Low Priority
12	176-190	14	Low	None	Low	
13	190-202	12	Low	Passing Lane at MP MP 190 - MP 195 (NB)	Low	Additional future planned projects or recommendations include: Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 194 - 201 (SB) - Tier 2 Medium Priority

5.3 Step 3: Mobility Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future level of service (LOS), percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks, and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter "grade" between "A" and "F" for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of "A", "B", and "C" are generally considered highly acceptable. A LOS value of "D" is generally considered moderately acceptable. LOS values of "E" and "F" are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper #2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Mobility-Related Infrastructure

Mobility-related infrastructure refers to devices or features at specific locations that influence mobility performance. Examples include dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of mobility-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor mobility performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Mobility Needs Contributing Factors

Table 11 summarizes the potential contributing factors to mobility needs on the SR 95 corridor.

Table 11: Mobility Needs Contributing Factors (Step 3)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Refined Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)	SB Buffer Index (PTI-TTI)	
1	29-34	5	Low	State Highway	Fringe Urban	Level	2	55	No	Non-Divided	N/A	A-C	A-C	15%	1.88	2.75	Passing Lane at MP 42 - 43 (NB)
2	34-43	9	Low	State Highway	Rural	Rolling	1	55	Yes	Non-Divided	27%	A-C	A-C	17%	1.17	0.14	None
3	43-60	17	Low	State Highway	Rural	Level	1	65	No	Non-Divided	19%	A-C	A-C	20%	0.18	0.15	None
4	60-80	20	Low	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	34%	A-C	A-C	24%	4.18	0.36	Passing Lane at MP 73 - 75 (NB)
5	80-104	24	Low	State Highway	Rural	Rolling	1	65	No	Non-Divided	2%	A-C	A-C	23%	0.13	0.48	None
6	104-111	2.5	Low	State Highway	Urban	Rolling	2	35	No	Non-Divided	N/A	A-C	A-C	20%	6.27	4.11	None
7	111-131	20	Low	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	57%	A-C	A-C	18%	0.25	0.38	Passing Lane at MP 120 - 118 (SB); Passing Lane at MP 129 - 130 (NB); Passing Lane at MP 130 - 131 (SB)
8	131-142	11	Low	State Highway	Rural	Rolling	1	55	No	Non-Divided	67%	A-C	A-C	15%	0.71	0.37	None
9	142-149	6	Low	State Highway	Urban	Rolling	2	55	No	Non-Divided	N/A	A-C	A-C	14%	6.04	3.28	Dynamic Message Sign at MP 143; Parking Area at MP 162 and MP 160
10	149-162	14	Low	State Highway	Rural	Rolling	1	55	Yes	Non-Divided	92%	A-C	A-C	18%	0.22	0.15	Passing Lane at MP 150 - 153 (SB); Passing Lane at MP 154 - 155 (SB); Parking Area at MP 162
11	162-176	14	Low	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	53%	A-C	A-C	23%	0.27	0.56	None
12	176-190	14	Low	State Highway	Urban	Rolling	2	55	No	Divided	N/A	A-C	E/F	29%	3.47	2.58	Passing Lane at MP 168 - 171 (NB); Passing Lane at MP 171 - 172 (SB)
13	190-202	12	Low	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	56%	A-C	A-C	34%	2.89	5.28	Passing Lane at MP 195 - 196 (NB/SB); Passing Lane at MP 198 - 200 (SB)

Table 11: Mobility Contributing Factors (Step 3)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final	Closure Extent							Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
1	29-34	5	Low	10	8	80%	2	20%	0	0%		- Percent of closures due to Incidents/Accidents and Obstructions/Hazards above statewide average - Two closures are due to flooding
2	34-43	9	Low	8	5	63%	3	38%	0	0%		- Percent of closures due to obstructions/hazards above statewide average - Three Closures are due to flooding - Consistent with the Southwest ADOT District's observation with low water crossings. - Construction of the Fortuna Wash Bridge at MP 34 may reduce closures due to flooding
3	43-60	17	Low	2	0	0%	2	100%	0	0%		- Percent of closures due to obstructions/hazards above statewide average - Both closures are due to flooding
4	60-80	20	Low	4	4	100%	0	0%	0	0%	Border Patrol Check Point at MP 75.5 (NB)	- Percent of closures due to Incidents/Accidents above statewide average
5	80-104	24	Low	7	6	86%	1	14%	0	0%		- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - One closure due to flooding
6	104-111	2.5	Low	1	1	100%	0	0%	0	0%		
7	111-131	20	Low	15	12	80%	3	20%	0	0%		- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - Two closures due to flooding
8	131-142	11	Low	7	6	86%	1	14%	0	0%		- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - One closure due to flooding
9	142-149	6	Low	19	18	95%	1	5%	0	0%		- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average
10	149-162	14	Low	18	17	94%	1	6%	0	0%		- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average
11	162-176	14	Low	28	28	100%	0	0%	0	0%		- Percent of closures due to incidents/accidents above statewide average
12	176-190	14	Low	35	35	100%	0	0%	0	0%		- Anticipated future growth in the urbanized Lake Havasu City area. Seasonal traffic fluctuations that includes a higher percentage of recreational vehicles during the winter months. - Interrupted flow conditions with higher signalized intersection density - Percent of closures due to incidents/accidents above statewide average
13	190-202	12	Low	17	16	94%	1	6%	0	0%		- Seasonal traffic fluctuations that includes a higher percentage of recreational vehicles during the winter months. - Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average

6 Safety Performance Needs (Steps 1-3)

The following sections describe the first three steps of the five-step needs assessment process described in Section 2 for the SR 95 corridor for the Safety Performance Area. The detailed methodology for performing Steps 1-3 is provided in the **Appendix**.

6.1 Step 1: Initial Safety Needs

The baseline performance scores (from Working Paper No. 2) and performance objectives (from Working Paper No. 3) for the SR 95 corridor were used to determine the initial safety needs, as described in Section 2.1.

Step 1 uses the scores for the Safety Index primary performance measure and two of the five secondary safety performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures used are the Directional Safety Index and the Strategic Highway Safety Plan (SHSP) Top 5 Emphasis Area Behaviors. The three other secondary safety performance measures (Truck-Involved Crashes, Motorcycle-Involved Crashes, and Non-Motorized Crashes) exhibited small crash sample sizes in their entirety and were not considered in the Safety Performance Area needs assessment (refer to sample size criteria documented in Working Paper No. 2). Corridor segments that exhibited small crash sample sizes for the SHSP Top 5 Emphasis Area Behaviors were also excluded from the safety needs assessment.

The performance scores, performance objectives, and initial levels of need for each safety performance measure and for all safety performance measures combined are shown in Table 12.

The initial need for all safety performance measures combined represents a weighted sum of individual safety performance measure levels of need. The initial need for a given segment may subsequently be modified (in Step 2) considering crash hot spots as well as relevant recently completed or under-construction projects that have or will improve safety performance compared to the baseline performance condition.

For the Safety Index, five segments report a high level of need and two segments report a medium level of need. For the secondary Directional Safety Index, seven segments report a high level of need northbound and three segments report a high level of need southbound, with one northbound medium level of need and one southbound medium level of need. For the SHSP Top 5 Emphasis Area Behaviors, two segments report high levels of need. As mentioned, Truck-Involved Crashes, Motorcycle-Involved Crashes, and Non-Motorized Crashes were not considered in the needs assessment due to small crash sample sizes. For all safety performance measures combined, five segments report a high level of initial need and two segments report a medium level of initial need.

Table 12: Initial Safety Needs (Step 1)

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				Performance Score	Performance Objective	Level of Need	NB Directional Safety Index	SB Directional Safety Index	Performance Objective	NB Level of Need	SB Level of Need	Performance Score	Performance Objective	Level of Need
1	4 or 5 Lane Undivided Highway	5	29-34	1.30	Average or Better	Medium	1.29	1.31	Average or Better	Medium	Medium	17%	Average or Better	None
2	2 or 3 Lane Undivided Highway	9	34-43	1.29	Average or Better	High	2.42	0.16	Average or Better	High	None	Insufficient Data	Average or Better	N/A
3	2 or 3 Lane Undivided Highway	17	43-60	0.07	Average or Better	None	0.13	0.00	Average or Better	None	None	Insufficient Data	Average or Better	N/A
4	2 or 3 Lane Undivided Highway	20	60-80	1.48	Average or Better	High	2.00	0.95	Average or Better	High	None	20%	Average or Better	None
5	2 or 3 Lane Undivided Highway	24	80-104	0.74	Average or Better	None	0.00	1.48	Average or Better	None	High	Insufficient Data	Average or Better	N/A
6	4 or 5 Lane Undivided Highway	2.5	104-111	2.23	Average or Better	High	4.46	0.00	Average or Better	High	None	Insufficient Data	Average or Better	N/A
7	2 or 3 Lane Undivided Highway	20	111-131	0.00	Average or Better	None	0.00	0.00	Average or Better	None	None	Insufficient Data	Average or Better	N/A
8	2 or 3 Lane Undivided Highway	11	131-142	0.14	Average or Better	None	0.28	0.00	Average or Better	None	None	75%	Average or Better	High
9	4 or 5 Lane Undivided Highway	6	142-149	1.10	Average or Better	Medium	2.13	0.07	Average or Better	High	None	17%	Average or Better	None
10	2 or 3 Lane Undivided Highway	14	149-162	0.62	Average or Better	None	0.28	0.96	Average or Better	None	None	50%	Average or Better	None
11	2 or 3 Lane Undivided Highway	14	162-176	1.91	Average or Better	High	1.89	1.93	Average or Better	High	High	64%	Average or Better	High
12	4 or 5 Lane Undivided Highway	14	176-190	1.77	Average or Better	High	1.63	1.91	Average or Better	High	High	45%	Average or Better	Low
13	2 or 3 Lane Undivided Highway	12	190-202	1.06	Average or Better	Medium	1.88	0.24	Average or Better	High	None	44%	Average or Better	None
Safety Emphasis Area?		**Yes**	**Weighted Average**	0.91	Above Average	Low								

Table 12: Initial Safety Needs (Step 1) (continued)

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	% of Fatal + Incapacitating Injury Crashes Involving Trucks			% of Fatal + Incapacitating Injury Crashes Involving Motorcycles			% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
1	4 or 5 Lane Undivided Highway	5	29-34	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
2	2 or 3 Lane Undivided Highway	9	34-43	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
3	2 or 3 Lane Undivided Highway	17	43-60	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
4	2 or 3 Lane Undivided Highway	20	60-80	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
5	2 or 3 Lane Undivided Highway	24	80-104	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
6	4 or 5 Lane Undivided Highway	2.5	104-111	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
7	2 or 3 Lane Undivided Highway	20	111-131	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
8	2 or 3 Lane Undivided Highway	11	131-142	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
9	4 or 5 Lane Undivided Highway	6	142-149	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
10	2 or 3 Lane Undivided Highway	14	149-162	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
11	2 or 3 Lane Undivided Highway	14	162-176	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
12	4 or 5 Lane Undivided Highway	14	176-190	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
13	2 or 3 Lane Undivided Highway	12	190-202	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium

6.2 Step 2: Final Safety Needs

Once the initial safety needs by segment for the SR 95 corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs.

An evaluation of crash hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in Table 13.

Crash Hot Spots

Directional crash concentration locations, as determined in the baseline performance evaluation, are considered crash hot spots. If a segment has an initial need level of None but contains a crash hot spot, the need level should be adjusted to Low to indicate there is a need on the segment. If a segment has some level of initial need (besides None) and also has a crash hot spot, no adjustment to the need level should be made. There is one crash hot spot on SR 95 at mileposts 179-190 in Segment 12, but as this segment was already identified as having needs, no further adjustment was made to the need level.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a safety need on a corridor segment. If a recently completed or under-construction project has a high likelihood to improve or address a performance need, the level of need for that segment was decreased.

The only potentially relevant recently completed project identified on the SR 95 corridor was a new northbound passing lane in Segment 13 at mileposts 190-195. The likely improvement in the Safety Index and northbound Directional Safety Index performance scores for Segment 13 due to the passing lane was estimated based on available crash modification factors for passing lanes and a new level of need calculated based on the improved performance score. The segment level of need changed from Medium to Low so the Final Need was updated accordingly.

Planned or Programmed Projects

Information was noted on safety-related planned and programmed projects and other issues identified in previous reports in Working Paper No. 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 13: Final Safety Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Hot Spots	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address need or other relevant issues identified in previous reports)
1	5	29-34	Medium	None	None	Medium	Programmed: H838801C, Roundabout at SR 95 / Avenue 8E at MP 31 (2016-2020 STIP), FY 2017
2	9	34-43	High	None	None	High	Programmed: Fortuna Wash Bridge at MP 34 (2016 anticipated construction); The bridge may not address segment's level of need based on the historical crash attributes
3	17	43-60	None	None	None	None	
4	20	60-80	High	None	None	High	Proposed Passing Lane at MP 76 - 82 (NB/SB) - Tier 3 Low Priority
5	24	80-104	Low	None	None	Low	Proposed Passing Lane at MP 88 - 90 (NB) - Tier 3 Low Priority Proposed Passing Lane at MP 92 - 98 (NB/SB) - Tier 3 Low Priority Proposed Passing Lane at MP 84 - 90 (SB) - Tier 3 Low Priority
6	2.5	104-111	High	None	None	High	
7	20	111-131	None	None	None	None	
8	11	131-142	Low	None	None	Low	Proposed Passing Lane at MP 132 - 139 (NB/SB) - Tier 2 Medium Priority
9	6	142-149	Medium	None	None	Medium	Programmed: H848901D, Construct Roundabout at SR 95 and Mohave Road at MP 142.9 (2016-2020 STIP), FY 2017
10	14	149-162	None	None	None	None	Proposed Passing Lane at MP 158 - 161 (NB) - Tier 2 Medium Priority Proposed Passing Lane at MP 152 - 155 (NB) - Tier 3 Low Priority
11	14	162-176	High	None	None	High	Proposed Passing Lane at MP 166 - 175 (SB) - Tier 2 Medium Priority Proposed Passing Lane at MP 166 - 173 (NB) - Tier 3 Low Priority
12	14	176-190	High	Large NB/SB crash concentration in Lake Havasu City area (MP 179 - 190)	None	High	
13	12	190-202	Medium	None	Passing Lane at MP 190 - MP 195 (NB). Passing Lane has crash modification factor of 0.75. Applying this reduction to the number of NB crashes changes the performance score, and the corresponding need level is now Low instead of Medium.	Low	Proposed Passing Lane at MP 194 - 201 (SB) - Tier 2 Medium Priority

6.3 Step 3: Safety Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors can be derived from:

- Hot spot crash summaries
- Previously completed safety-related projects
- District input on safety concerns
- Segment crash type summaries
- Section 6.2 of the 2010 Highway Safety Manual

Hot Spot Crash Summaries

Crash summaries were developed for each identified crash hot spot to identify observable crash patterns. These crash summaries are based on crashes of all severity levels (not just fatal and incapacitating injury) to provide more information for use in identifying crash patterns.

Previously Completed Safety-Related Projects

Recently completed safety-related projects may provide insight into previously identified contributing factors along the corridor. Some recently completed safety-related projects may already address some of the crash patterns evident in the crash analysis. Other safety-related projects completed before the crash analysis time period (i.e., more than five years old) may have exceeded their respective design life and rehabilitation or replacement could increase their effectiveness. Examples include rumble strips that are worn down or retroreflective materials that have lost their retroreflectivity.

District Input on Safety Concerns

ADOT maintenance personnel provided information on locations where they had observed potential safety needs. Locations were defined by approximate milepost limits and assigned to the appropriate corridor segment. District safety concerns that corroborated the segment crash type summaries or crash hot spots summaries were noted.

Segment Crash Type Summaries

Crash frequencies for each possible crash type descriptor within each of the eight crash type summary categories were summarized for fatal and incapacitating injury crashes for each corridor segment that contained at least five crashes of that crash type descriptor (lower crash totals were not considered to have a sufficient sample size for analysis purposes). For an even more robust data set, crash types for crashes of all severity levels (not just fatal and incapacitating injury) can be reviewed to determine if crash patterns are readily identifiable. If this more detailed analysis is conducted, it is recommended that it only be conducted on segments with medium or high levels of need to minimize analysis effort.

The proportional occurrence of each possible crash type descriptor compared to the total number of fatal plus incapacitating injury crashes occurring in that respective segment was also calculated and expressed as a percentage. These segment-level crash type descriptor frequency percentages were then compared with the corresponding statewide crash type descriptor frequency percentages for all state highways with similar operating environments (as defined in the baseline corridor performance in Working Paper #2). Segment crash type descriptor frequency percentages that exceeded the corresponding statewide frequency percentage were identified as likely contributing factors to the level of need (illustrated with a red font). The crash type descriptors include the following components:

- First Harmful Event Type
  - Collision with Motor Vehicle
  - Overturning
  - Collision with Pedestrian
  - Collision with Pedalcyclist
  - Collision With Animal
  - Collision with Fixed Object
  - Collision with Non-Fixed Object
  - Vehicle Fire or Explosion
  - Other Non-Collision
  - Unknown
- Collision Type
  - Single Vehicle Collisions
  - Angle
  - Left Turn
  - Rear End
  - Head On
  - Sideswipe (same)
  - Sideswipe (opposite)
  - Rear to Side
  - Rear to Rear
  - Other
  - Unknown
- Violation or Behavior Type
  - No Improper Action
  - Speed too Fast for Conditions
  - Exceeded Lawful Speed
  - Failure to Yield Right-of-Way
  - Followed Too Closely
  - Ran Stop Sign
  - Disregarded Traffic Signal
  - Made Improper Turn
  - Drove in Opposing Lane
  - Faulty/Missing Equipment
  - Motorcycle Safety Equipment Use
  - Passed in No Passing Zone
  - Unsafe Lane Change
  - Failure to Keep in Proper Lane
  - Other Unsafe Passing
  - Inattention/Distraction
  - Electronic Communications Device
  - Other
- Type of Lighting Conditions
  - Daylight
  - Dawn
  - Dusk
  - Dark-Lighted
  - Dark-Unlighted

  - Dark-Unknown Lighting
- Type of Road Surface Conditions
  - Dry
  - Wet
  - Snow
  - Slush
  - Ice/Frost
  - Water (standing or moving)
  - Sand
  - Mud, Dirt, Gravel
  - Oil
  - Other
  - Unknown
- First Unit Event Description
  - Collision with Animal
  - Collision with Fixed Object
  - Ran Off the Road (Left)
  - Ran Off the Road (Right)
  - Crossed Centerline
  - Crossed Median
  - Collision with Pedestrian
  - Motor Vehicle in Transport
  - Overturn
  - Equipment Failure
  - Collision with Falling Object
  - Other Non-Collision
  - Other Non-Fixed Object
  - Unknown
- Driver Physical Condition
  - Under the Influence of Drugs or Alcohol
  - Fatigued/Fell Asleep
  - No Apparent Influence
  - Had Been Drinking
  - Medications
  - Illness
  - Physical Impairment
  - Other
  - Unknown
- Safety Device Usage
  - Shoulder and Lap Belt
  - Child Restraint System
  - None Used
  - Helmet Used
  - Air Bag Deployed/Shoulder-Lap Belt
  - Air Bag Deployed
  - Other
  - Unknown
  - Not Applicable
  - Lap Belt
  - Not Reported

Section 6.2 of the 2010 Highway Safety Manual
Section 6.2 of the *2010 Highway Safety Manual* (HSM) provides potential contributing factors for corresponding crash types and patterns. Crash patterns within the corridor that match crash patterns in the HSM can reasonably be expected to have similar potential contributing factors to those listed in the HSM.

Safety Needs Contributing Factors
Likely contributing factors were developed based on the information obtained through the hot spot crash summaries, previously completed safety-related projects, District input on safety concerns, segment crash type summaries, and HSM potential contributing factors. These contributing factors provide guidance on the types of solutions that will likely promote improved safety performance. Table 14 summarizes the likely contributing factors to safety needs on the SR 95.

Table 14: Safety Needs Contributing Factors (Step 3)

		1	2	3	4	5	6	7	8	9
Segment Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Segment Length (miles)		**5**	**9**	**17**	**20**	**24**	**2.5**	**20**	**11**	**6**
Segment Milepost (MP)		**29-34**	**34-43**	**43-60**	**60-80**	**80-104**	**104-111**	**111-131**	**131-142**	**142-149**
Final Need		Medium	High	None	High	Low	High	None	Low	Medium
Segment Crash Overview		2 Crashes were fatal 4 Crashes had incapacitating injuries 3 Crashes involve trucks	2 Crashes were fatal 3 Crashes had incapacitating injuries 2 Crashes involve trucks	0 Crashes were fatal 2 Crashes had incapacitating injuries	3 Crashes were fatal 2 Crashes had incapacitating injuries 1 Crashes involve trucks	2 Crashes were fatal 0 Crashes had incapacitating injuries	1 Crashes were fatal 0 Crashes had incapacitating injuries	No Crashes Reported	0 Crashes were fatal 4 Crashes had incapacitating injuries 1 Crashes involve trucks	2 Crashes were fatal 4 Crashes had incapacitating injuries 2 Crashes involve trucks
Segment Crash Summaries (Fatal and Serious Injury Crashes)	**First Harmful Event Type**	**83% Involve Collision with Motor Vehicle** 17% Involve Collision with Pedestrian	**60% Involve Collision with Motor Vehicle** **20% Collision with Non-Fixed Object** **20% Involve Collision with Fixed Object**	N/A - Sample size too small	**80% Involve Overturning** **20% Involve Vehicle Fire or Explosion**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	**83% Involve Collision with Motor Vehicle** **17% Involve Collision with Pedestrian**
	Collision Type	50% Involve Angle **33% Involve Left Turn** **17% Involve Other**	**40% Involve Rear End** **40% Other** 20% Involve Single Vehicle	N/A - Sample size too small	**100% Involve Single Vehicle**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	**50% Involve Angle** **33% Involve Left Turn** **17% Involve Other**
	Violation or Behavior	**33% Disregarded Traffic Signal** **33% Involve Failure to Yield Right-of-Way** **17% Involve No Improper Action**	**40% Involve Inattention/Distraction** **20% Failure to Yield Right-of-Way** **20% Involve No Improper Action**	N/A - Sample size too small	**60% Involve No Improper Action** **20% Involve Inattention/Distraction** **20% Unknown**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	**33% Involve Disregarded Traffic Signal** **17% Involve Failure to Yield Right-of-Way** **17% Drove in Opposing Lane**
	Lighting Conditions	**83% Occur in Daylight Conditions** **17%** Occur in Dark-Lighted Conditions	60% Occur in Daylight Conditions **40% Occur in Dark-Unlighted Conditions**	N/A - Sample size too small	**80% Occur in Daylight Conditions** **20% Occur in Dusk Conditions**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	33% Occurred in Dark-Lighted Conditions 33% Occur in Daylight Conditions **17% Occur in Dawn Conditions**
	Surface Conditions	**100% Involve Dry Conditions**	**100% Involve Dry Conditions**	N/A - Sample size too small	**100% Involve Dry Conditions**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	**100% Involve Dry Conditions**
	First Unit Event	**83% Involve a first unit event of Motor Vehicle in Transport** **17% Involve a first unit event of Collision with Pedestrian**	**60% Involve a first unit event of Motor Vehicle in Transport** **20% Involve a first unit event of Equipment Failure** **20% Involve a first unit event of Ran Off the Road (Left)**	N/A - Sample size too small	**60% Involve a first unit event of Equipment Failure** 20% Other Non-Collision 20% Ran Off the Road (Right)	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	67% Involve a first unit event of Motor Vehicle in Transport **33% Involve a first unit event of Crossed Centerline**
	Driver Physical Condition	50% No Apparent Influence **33% Unknown** **17% Under the Influence of Drugs or Alcohol**	**80% No Apparent Influence** 20% Unknown	N/A - Sample size too small	**80% No Apparent Influence** 20% Unknown	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	50% No Apparent Influence **33% Unknown** **17% Under the Influence of Drugs or Alcohol**
	Safety Device Usage	**83% Shoulder And Lap Belt Used** 17% Air Bag Deployed/Shoulder-Lap Belt	**80% Shoulder And Lap Belt Used** **20% Helmet Used**	N/A - Sample size too small	**100% Shoulder and Lap Belt Used**	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	**33% None Used** **33% Airbag Deployed/Shoulder-Lap Belt** 17% Shoulder And Lap Belt Used
Hot Spot Crash Summaries		None	None	None	None	None	None	N/A	None	None
Previously Completed Safety-Related Projects										
District Interviews/Discussions			Animal related crashes common within the Southwest district of SR 95 (MP 34 - 55) Southwest District noted that low water crossings can have the potential to be a safety issue	Animal related crashes common within the Southwest district of SR 95 (MP 34 - 55) Southwest District noted that low water crossings can have the potential to be a safety issue	Include Low-water crossings input from the district that may include safety issues.					
Contributing Factors		- Limited or restricted sight distance - High approach speed - Misjudge speed of on-coming traffic - Lack of crossing opportunity for pedestrians - Drivers running red light or stop sign - Failure to yield the right-of-way Comment: Programmed traffic signal at the intersection of Avenue 8E	- Driver inattention - Large number of turning vehicles - Drivers running red light or stop sign - Poor nighttime visibility or lighting - Obstruction in or near roadway - Inadequate signs, delineators, guardrail - Roadside design (Inadequate clear distance)	N/A	- Roadside Design (non-traversable side slops) - Inadequate shoulder width - Driver inattention - Poor Delineation	N/A - Sample size too small	N/A - Sample size too small	N/A	N/A - Sample size too small	- Unadequate sight distance - Drivers running red light or stop sign - Excessive speed - Poor nighttime visibility or lighting - Inadequate roadway geometry - Inadequate pavement markings Comment: Programmed traffic signal at SR 95 and Mohave Road

Table 14: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		**10**	**11**	**12**	**13**	**Corridor-Wide Crash Characteristics**
Segment Length (miles)		**14**	**14**	**14**	**12**	
Segment Milepost (MP)		**149-162**	**162-176**	**176-190**	**190-202**	
Final Need		None	High	High	Low	
Segment Crash Overview		1 Crashes were fatal 7 Crashes had incapacitating injuries 0 Crashes involve trucks	4 Crashes were fatal 10 Crashes had incapacitating injuries 0 Crashes involve trucks	5 Crashes were fatal 92 Crashes had incapacitating injuries 5 Crashes involve trucks	2 Crashes were fatal 7 Crashes had incapacitating injuries 1 Crashes involve trucks	24 Crashes were fatal 135 Crashes had incapacitating injuries 15 Crashes involve trucks
Segment Crash Summaries (Fatal and Serious Injury Crashes)	**First Harmful Event Type**	**63% Involve Collision with Fixed Object** 25% Involve Collision with Motor Vehicle **13% Involve Collision with Pedestrian**	**43% Involve Collision with Motor Vehicle** **21% Involve Other Non-Collision** 14% Involve Overturning	**86% Involve Collision with Motor Vehicle** **9% Involve Overturning** 2% Involve Other Non-Collision	33% Involve Collision with Motor Vehicle **22% Involve Collision with Fixed Object** 11% Involve Overturning	70% Involve Collision with Motor Vehicle 12% Involve Overturning 7% Involve Collision with Fixed Object
	Collision Type	50% Involve Single Vehicle **13% Involve Rear End** **13% Involve Head On**	43% Involve Single Vehicle **14% Involve Rear End** **14% Involve Head On**	**33% Involve Rear End** **29% Involve Angle** 13% Involve Single Vehicle	56% Involve Single Vehicle **22% Involve Head On Collision** **11% Involve Angle**	24% Involve Single Vehicle 23% Involve Angle 22% Involve Rear End
	Violation or Behavior	**25% Failure to Keep in Proper Lane** **25% Speed to Fast for Conditions** **13% Drove in Opposing Lane**	**21% Involve Drove in Opposing Lane** **14% Inattention/Distraction** **14% Ran Stop Sign**	**28% Involve Disregarded Traffic Signal** **23% Involve Inattention/Distraction** 9% Involve Speed too Fast for Conditions	**22% Involve No Improper Action** **22% Drove in Opposing lane** **22% Other**	20% Involve Disregarded Traffic Signal 16% Involve Inattention/Distraction 11% Involve No Improper Action
	Lighting Conditions	**38% Occur in Dark-Unlighted Conditions** 25% Occur in Daylight Conditions 25% Occur in Dusk Conditions	**50% Occur in Dark-Unlighted Conditions** 50% Occur in Daylight Conditions	**80% Occur in Daylight Conditions** 9% Occur in Lighted Conditions 9% Occur in Dark-Lighted Conditions	**89% Occur in Daylight Conditions** 11% Occur in Dark-Unlighted Conditions	70% Occur in Daylight Conditions 18% Occur in Dark-Unlighted Conditions 9% Occur in Dark-Lighted Conditions
	Surface Conditions	75% Involve Dry Conditions **25% Involve Wet Conditions**	**93% Involve Dry Conditions** **7% Involve Wet Conditions**	**99% Involve Dry Conditions** 1% Involve Wet Conditions	78% Involve Dry Conditions **22% Involve Wet Conditions**	96% Involve Dry Conditions 4% Involve Wet Conditions
	First Unit Event	**50% Involve a first unit event of Crossed Centerline** **25% Involve a first unit event of Other Non-Collision** **13% Involve a first unit event of Collision with Fixed Object**	36% Involve a first unit event of Ran Off the Road (Right) 29% Involve a first unit event of Motor Vehicle in Transport 7% Collision with Pedestrian	**78% Involve a first unit event of Motor Vehicle in Transport** 7% Involve a first unit event of Crossed Centerline **6% Involve a first unit event of Overturning**	**33% Involve a first unit event of Ran Off the Road (Right)** **11% Involve Collision with Fixed Object** **11% Equipment Failure**	60% Involve a first unit event of Motor Vehicle in Transport 14% Involve a first unit event of Crossed Centerline 9% Involve a first unit event of Ran Off the Road (Right)
	Driver Physical Condition	38% No Apparent Influence **25% Under the Influence of Drugs or Alcohol** **13% Fatigued/Fell Asleep**	36% Unknown 36% No Apparent Influence 14% Under the Influence of Drugs or Alcohol	**66% No Apparent Influence** 17% Unknown 11% Under the Influence of Drugs or Alcohol	**33% Under the Influence of Drugs or Alcohol** 33% No Appaent Influence **11% Illness**	57% No Apparent Influence 21% Unknown 14% Under the Influence of Drugs or Alcohol
	Safety Device Usage	25% Air Bag Deployed/Shoulder-Lap Belt 25% Shoulder And Lap Belt Used 25% None Used	36% None Used **29% Helmet Used** 36% Shoulder and Lap Belt Used	**72% Shoulder And Lap Belt Used** 14% None Used 3% Unknown	33% Shoulder And Lap Belt Used **22% Unknown** **11% Air Bag Deployed**	61% Shoulder And Lap Belt Used 16% None Used 7% Helmet Used
Hot Spot Crash Summaries		None	None	Hot Spot within the Lake Havasu City limits, both directions (MP 179 - 190)	None	
Previously Completed Safety-Related Projects					Passing Lane at MP 190 - MP 195 (NB)	
District Interviews/Discussions				Lack of access control measures in the northorn portion of segment 12. Higher concentration of crashes due to vehicles making left-turns		
Contributing Factors		- Obstruction in or near roadway - Poor nighttime visibility or lighting - Poor sign visibility - Roadside design (Inadequate clear distance) - Unexpected stops on approach - Excessive speed - Inadequate pavement markings	- Poor nighttime visibility or lighting - Inadequate pavement markings - Inadequate roadway shoulders - Roadside design (non-traversable side slopes) - Driver inattention	- Drivers running red light or stop sign - Driver inattention - Inadequate signal timing - Poor visibiliity of signals - Unexpected stops on approach - Excessive speed - Misjudge speed of on-coming traffic	- Obstruction in or near roadway - Inadequate roadway shoulders - Inadequate pavement markings - Inadequate signs, delineators, guardrail - Roadside design (Inadequate clear distance)	- Inadequate roadway shoulders - Inadequate signs, delineators, guardrail - Driver inattention - Unexpected stops on aproach - Unexpected lane changes on approach

7 Freight Performance Deficiencies (Steps 1-3)

The following sections describe the first three steps of the five-step needs assessment process described in Section 2 for the SR 95 corridor for the Freight Performance Area. The detailed methodology for performing Steps 1-3 is provided in the **Appendix**.

7.1 Step 1: Initial Freight Needs

The baseline performance scores (from Working Paper No. 2) and performance objectives (from Working Paper No. 3) for the SR 95 corridor were used to determine the initial freight needs, as described in Section 2.1. Step 1 uses the scores for the Freight Index primary performance measure and four secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The four secondary performance measures are Directional Truck Travel Time Index (TTTI), Directional Truck Planning Time Index (TPTI), Directional Closure Duration, and Bridge Vertical Clearance. The performance scores, performance objectives, and initial levels of need for each freight performance measure and for all freight performance measures combined are shown in Table 15.

The initial need for all freight performance measures combined represents a weighted sum of individual freight performance measure levels of need. The initial need for a given segment may subsequently be modified (in Step 2) considering Vertical Clearance Hot Spots as well as relevant recently completed or under-construction projects that have or will improve freight performance compared to the baseline performance condition.

For the Freight Index, four segments and the corridor overall report a high level of need and six segments report a medium level of need. For Directional TTTI, two segments have a high level of need southbound and one segment has a medium level of need northbound. For Directional TPTI, six segments report a high level of need northbound and two segments report a high level of need southbound, with three northbound medium levels of need and seven southbound medium levels of need. For Directional Closure Duration, one segment has a high level of need southbound and three segments have a medium level of need northbound. For Bridge Vertical Clearance, no segments report a level of need. For all freight performance measures combined, eight segments report a high level of initial need and two segments report a medium level of initial need.

Table 15: Initial Freight Needs (Step 1)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTI (trucks only)					Directional PTI (trucks only)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							NB	SB		NB	SB	NB	SB		NB	SB
1	Interrupted	29-34	5	0.28	Fair or Better	None	1.15	1.19	Fair or Better	None	None	3.70	3.32	Fair or Better	None	None
2	Uninterrupted	34-43	9	0.62	Fair or Better	High	1.08	1.00	Fair or Better	None	None	2.03	1.17	Fair or Better	High	None
3	Uninterrupted	43-60	17	0.79	Fair or Better	None	1.03	1.03	Fair or Better	None	None	1.25	1.28	Fair or Better	None	None
4	Uninterrupted	60-80	20	0.13	Fair or Better	High	1.28	1.11	Fair or Better	Medium	None	13.66	1.52	Fair or Better	High	Medium
5	Uninterrupted	80-104	24	0.72	Fair or Better	Low	1.04	1.11	Fair or Better	None	None	1.13	1.65	Fair or Better	None	High
6	Interrupted	104-111	2.5	0.29	Fair or Better	None	1.62	1.44	Fair or Better	Low	None	3.23	3.62	Fair or Better	None	None
7	Uninterrupted	111-131	20	0.68	Fair or Better	Medium	1.10	1.09	Fair or Better	None	None	1.46	1.50	Fair or Better	Medium	Medium
8	Uninterrupted	131-142	11	0.55	Fair or Better	High	1.04	1.02	Fair or Better	None	None	2.22	1.44	Fair or Better	High	Medium
9	Interrupted	142-149	6	0.18	Fair or Better	Medium	1.41	1.33	Fair or Better	None	None	7.04	4.27	Fair or Better	High	Low
10	Uninterrupted	149-162	14	0.79	Fair or Better	None	1.10	1.00	Fair or Better	None	None	1.41	1.13	Fair or Better	Low	None
11	Uninterrupted	162-176	14	0.64	Fair or Better	Medium	1.18	1.10	Fair or Better	None	None	1.56	1.55	Fair or Better	Medium	Medium
12	Interrupted	176-190	14	0.22	Fair or Better	Medium	1.32	1.28	Fair or Better	None	None	5.29	3.96	Fair or Better	Medium	None
13	Uninterrupted	190-202	12	0.19	Fair or Better	High	1.31	2.74	Fair or Better	Medium	High	3.09	7.66	Fair or Better	High	High
Emphasis Area?	Yes	**Weighted Average**		0.52	Good	High										

Table 15: Initial Freight Needs (Step 1) (continued)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Closure Duration (hours/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
				NB	SB		NB	SB				
1	Interrupted	29-34	5	117.61	14.88	Fair or Better	Medium	None	No UP	Fair or Better	None	Low
2	Uninterrupted	34-43	9	27.89	3.62	Fair or Better	None	None	No UP	Fair or Better	None	High
3	Uninterrupted	43-60	17	28.05	0.00	Fair or Better	None	None	No UP	Fair or Better	None	None
4	Uninterrupted	60-80	20	10.18	2.19	Fair or Better	None	None	No UP	Fair or Better	None	High
5	Uninterrupted	80-104	24	2.68	7.13	Fair or Better	None	None	No UP	Fair or Better	None	Low
6	Interrupted	104-111	2.5	0.00	46.96	Fair or Better	None	None	No UP	Fair or Better	None	Medium
7	Uninterrupted	111-131	20	133.60	7.49	Fair or Better	Medium	None	No UP	Fair or Better	None	High
8	Uninterrupted	131-142	11	10.13	166.29	Fair or Better	None	High	No UP	Fair or Better	None	High
9	Interrupted	142-149	6	106.46	22.77	Fair or Better	Medium	None	27.83	Fair or Better	None	High
10	Uninterrupted	149-162	14	39.55	33.24	Fair or Better	None	None	No UP	Fair or Better	None	Low
11	Uninterrupted	162-176	14	27.94	53.85	Fair or Better	None	None	No UP	Fair or Better	None	Medium
12	Interrupted	176-190	14	67.30	11.80	Fair or Better	None	None	16.41	Fair or Better	None	Medium
13	Uninterrupted	190-202	12	18.23	20.92	Fair or Better	None	None	No UP	Fair or Better	None	High

7.2 Step 2: Final Freight Needs

Once the initial freight needs by segment for the SR 95 corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of vertical clearance hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in Table 16.

Vertical Clearance Hot Spots

Bridges that provide less than 16.25 feet of vertical clearance above the corridor mainline through lanes and that cannot be ramped around are considered vertical clearance hot spots. If a segment has an initial need level of None but contains a vertical clearance hot spot, the need level should be adjusted to Low to indicate there is a need on the segment. If a segment has some level of initial need (besides None) and also has a vertical clearance hot spot, no adjustment to the need level should be made. There are no vertical clearance hot spots on SR 95 so no adjustment was made to need levels.

Recently Completed and Under-Construction Freight Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a freight need on a corridor segment. If a recently completed or under-construction project has a high likelihood to improve or address a performance need, the level of need for that segment was decreased.

The only potentially relevant recently completed project identified on the SR 95 corridor was a new northbound passing lane in Segment 13 at mileposts 190-195. The likely improvement in the northbound TTTI and TPTI performance score for Segment 13 due to the passing lane was estimated and a new level of need calculated based on the improved performance score. The segment level of need remained High despite the passing lane improvement (likely due to the poor southbound performance) so no adjustment was made to the initial need for Segment 13.

Planned or Programmed Projects

Information was noted on freight-related planned and programmed projects and other issues identified in previous reports in Working Paper No. 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 16: Final Freight Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address needs or other relevant issues identified in previous reports)
1	5	29-34	Low	None	None	Low	
2	9	34-43	High	None	None	High	
3	17	43-60	None	None	None	None	
4	20	60-80	High	None	None	High	
5	24	80-104	Low	None	None	Low	
6	2.5	104-111	Low	None	None	Low	
7	20	111-131	High	None	None	High	
8	11	131-142	High	None	None	High	
9	6	142-149	High	None	None	High	
10	14	149-162	Low	None	None	Low	
11	14	162-176	Medium	None	None	Medium	
12	14	176-190	Medium	None	None	Medium	
13	12	190-202	High	None	Passing Lane at MP 190 - MP 195 (NB)	High	Adjustment to the Northbound Average TPTI to estimate the impact of the recently constructed passing lane showed no change in the Level of Need for this segment.

7.3 Step 3: Freight Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future level of service (LOS), percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks, and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter "grade" between "A" and "F" for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of "A", "B", and "C" are generally considered highly acceptable. A LOS value of "D" is generally considered moderately acceptable. LOS values of "E" and "F" are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper #2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Freight-Related Infrastructure

Freight related infrastructure refers to devices or features at specific locations that influence freight performance. Examples include dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), weigh stations, rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of freight-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor freight performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection. There is an existing border patrol checkpoint on northbound US 95 at milepost 75.5.

Freight Needs Contributing Factors

Table 17 summarizes the potential contributing factors to freight needs on the SR 95 corridor.

Table 17: Freight Needs Contributing Factors (Step 3)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Freight Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (TPTI-TTTI)	SB Buffer Index (TPTI-TTTI)	
1	29-34	5	Low	State Highway	Fringe Urban	Level	2	55	No	Non-Divided	N/A	A-C	A-C	15%	2.55	2.13	Passing Lane at MP 42 - 43 (NB)
2	34-43	9	High	State Highway	Rural	Rolling	1	55	Yes	Non-Divided	27%	A-C	A-C	17%	0.95	0.17	None
3	43-60	17	None	State Highway	Rural	Level	1	65	No	Non-Divided	19%	A-C	A-C	20%	0.22	0.25	None
4	60-80	20	High	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	34%	A-C	A-C	24%	12.38	0.41	Passing Lane at MP 73 - 75 (NB)
5	80-104	24	Low	State Highway	Rural	Rolling	1	65	No	Non-Divided	2%	A-C	A-C	23%	0.10	0.54	None
6	104-111	2.5	Low	State Highway	Urban	Rolling	2	35	No	Non-Divided	N/A	A-C	A-C	20%	1.61	2.18	None
7	111-131	20	High	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	57%	A-C	A-C	18%	0.36	0.41	Passing Lane at MP 120 - 118 (SB); Passing Lane at MP 129 - 130 (NB); Passing Lane at MP 130 - 131 (SB)
8	131-142	11	High	State Highway	Rural	Rolling	1	55	No	Non-Divided	67%	A-C	A-C	15%	1.17	0.42	None
9	142-149	6	High	State Highway	Urban	Rolling	2	55	No	Non-Divided	N/A	A-C	A-C	14%	5.64	2.94	Dynamic Message Sign at MP 143; Parking Area at MP 162 and MP 160
10	149-162	14	Low	State Highway	Rural	Rolling	1	55	Yes	Non-Divided	92%	A-C	A-C	18%	0.31	0.13	Passing Lane at MP 150 - 153 (SB); Passing Lane at MP 154 - 155 (SB); Parking Area at MP 162
11	162-176	14	Medium	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	53%	A-C	A-C	23%	0.38	0.45	None
12	176-190	14	Medium	State Highway	Urban	Rolling	2	55	No	Divided	N/A	A-C	E/F	29%	3.97	2.68	Passing Lane at MP 168 - 171 (NB); Passing Lane at MP 171 - 172 (SB)
13	190-202	12	High	State Highway	Rural	Rolling	1	65	Yes	Non-Divided	56%	A-C	A-C	34%	1.78	4.92	Passing Lanes at MP 195 - 196 (NB/SB); Passing Lane at MP 198 - 200 (SB)

Table 17: Freight Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
1	29-34	5	Low	10	8	80%	2	20%	0	0%		Final DCR for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane	- Percent of closures due to Incidents/Accidents and Obstructions/Hazards above statewide average - Two closures are due to flooding
2	34-43	9	High	8	5	63%	3	38%	0	0%		Programmed: Fortuna Wash Bridge at MP 34 (2016 anticipated construction) Final DCR for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane	- Percent of closures due to obstructions/hazards above statewide average - Three Closures are due to flooding - Consistent with the Yuma District observation with low water crossings.
3	43-60	17	None	2	0	0%	2	100%	0	0%		Final DCR for US-95 (MP 31.85 - 50.35), Avenue 9E to Aberdeen Road; Widen from a 2-lane to a 4-lane highway with a continuous left-turn lane Final DCR for US 95 (MP 42 to Cibola Lake Road); Widen to four lanes	- Percent of closures due to obstructions/hazards above statewide average - Both closures are due to flooding
4	60-80	20	High	4	4	100%	0	0%	0	0%	Border Patrol Check Point at MP 75.5 (NB)	Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 76 - 82 (NB/SB) - Tier 3 Low Priority Final DCR for US 95 (MP 42 to Cibola Lake Road); Widen to four lanes	- Percent of closures due to Incidents/Accidents above statewide average
5	80-104	24	Low	7	6	86%	1	14%	0	0%		Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 88 - 90 (NB) - Tier 3 Low Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 92 - 98 (NB/SB) - Tier 3 Low Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 84 - 90 (SB) - Tier 3 Low Priority	- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - One closure due to flooding
6	104-111	2.5	Low	1	1	100%	0	0%	0	0%			
7	111-131	20	High	15	12	80%	3	20%	0	0%			- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - Two closures due to flooding
8	131-142	11	High	7	6	86%	1	14%	0	0%		Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 132 - 139 (NB/SB) - Tier 2 Medium Priority	- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average - One closure due to flooding '

Table 17: Freight Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
9	142-149	6	High	19	18	95%	1	5%	0	0%		*Programmed:* Construct Roundabout at SR 95 and Mohave Road at MP 142.9	- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average
10	149-162	14	Low	18	17	94%	1	6%	0	0%		Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 158 - 161 (NB) - Tier 2 Medium Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 152 - 155 (NB) - Tier 3 Low Priority	- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average
11	162-176	14	Medium	28	28	100%	0	0%	0	0%		Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 166 - 175 (SB) - Tier 2 Medium Priority	- Percent of closures due to incidents/accidents above statewide average
12	176-190	14	Medium	35	35	100%	0	0%	0	0%			- Anticipated future growth in the Lake Havasu City area. - Percent of closures due to incidents/accidents above statewide average
13	190-202	12	High	17	16	94%	1	6%	0	0%		Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 194 - 201 (SB) - Tier 2 Medium Priority Climbing and Passing Lane Prioritization Study; Proposed Passing Lane at MP 166 - 173 (NB) - Tier 3 Low Priority	- Percent of closures due to incidents/accidents and Obstructions/Hazards above statewide average
						76%		3%		5%	Note: Includes border patrol check points and other closures/restrictions not controlled by ADOT.	Note: Existing and Planned Infrastructure Source: 2012 Highway Log, Climbing and Passing Lane Prioritization Study, ADOT 5-year Construction Program	Note: Statewide averages determined from Highway Condition Reporting System (HCRS) data for 2009-2013 for ADOT's nine designated strategic corridors Note: Roadway vertical grade, number of lanes, and presence/lack of a climbing lane should be a consideration if deficiencies are due to PTI or TTI
			Statewide HCRS Database Closure Type Average %:										

8 Segment Review (Step 4)

As part of Step 4, the final deficiency results for each segment were combined to estimate the average level of need for each segment of SR 95, as described in Section 2.4. During the Corridor Vision process for SR 95, the Freight, Safety, and Mobility Performance Areas were identified as Emphasis Areas. Therefore, a weighting factor of 1.50 was applied to those deficiencies as discussed in Section 2.4. A summary of the segment needs is shown in Table 18 along with the resulting average deficiency. These results are intended for use to compare the level of need across corridors. The average level of need by segment is shown for the SR 95 corrido in Figure 7.

Table 18: Segment Needs Summary

Performance Area	95-1	95-2	95-3	95-4	95-5	95-6	95-7	95-8	95-9	95-10	95-11	95-12	95-13
Pavement	None	None	None	None	None	Low	None	Low	Low	None	None	Low	None
Bridge	None	None	Medium	None	None	None	None	Medium	None	None	None	Medium	None
Mobility	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Safety	Medium	High	None	High	Low	High	None	Low	Medium	None	High	High	Low
Freight	Low	High	None	High	Low	Low	High	High	High	Low	Medium	Medium	High
Average Need (0-3)	**0.92**	**1.62**	**0.54**	**1.62**	**0.69**	**1.31**	**0.92**	**1.62**	**1.54**	**0.46**	**1.38**	**1.85**	**1.15**

Need Category	Average Need Range
Low	0.10 - 1.00
Medium	1.00 - 2.00
High	> 2.00

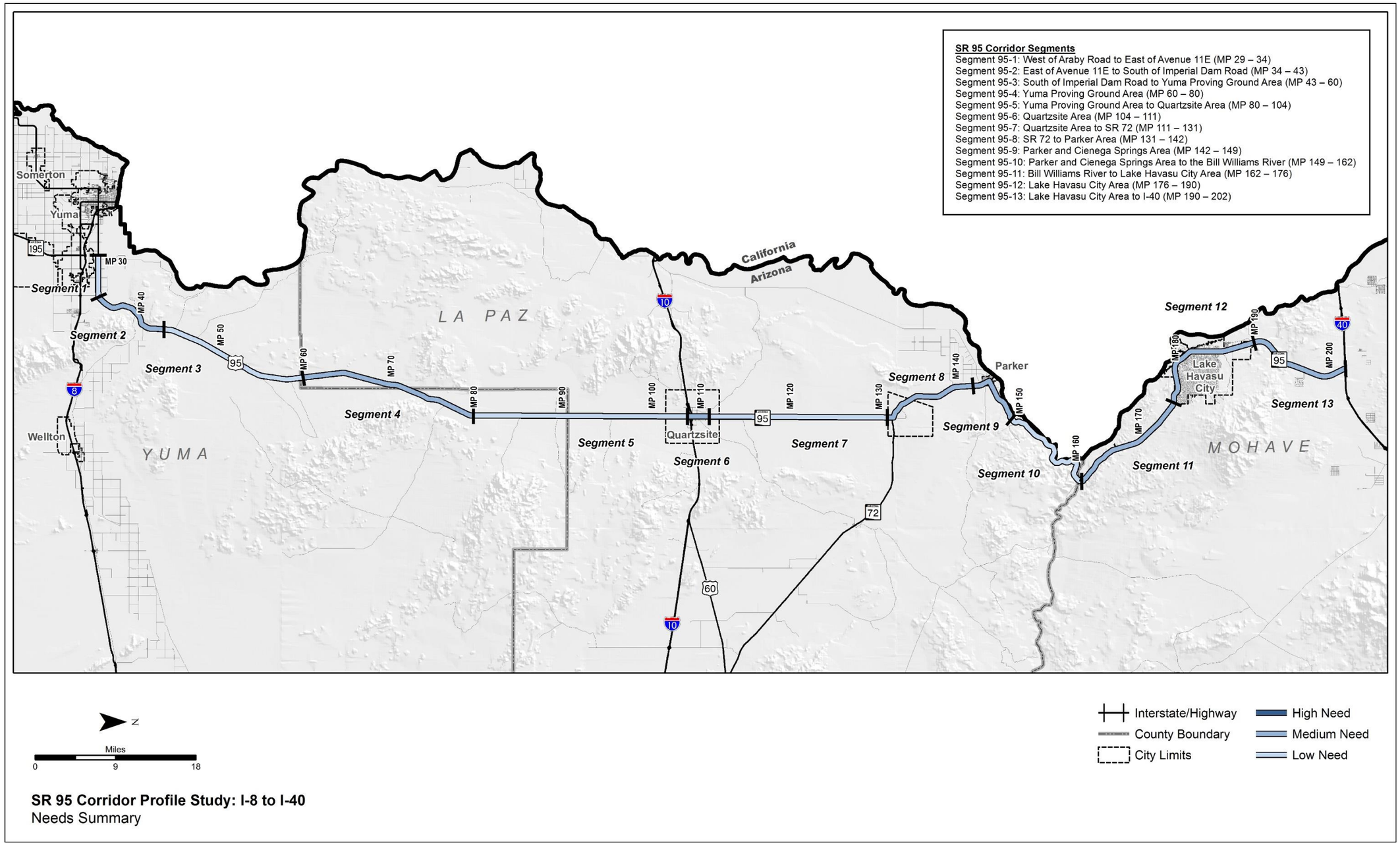


Figure 7: Final Needs Ratings

9 Corridor Needs (Step 5)

Step 5 translates the performance-based needs into corridor needs that are “actionable”. These needs can facilitate development of solution sets (projects, initiatives, countermeasures, and programs) to improve corridor performance through strategic investments in preserving, modernizing, and/or expanding the corridor. Corridor needs were developed through a segment-by-segment review of needs and contributing factors. This review also identified overlapping, common, and contrasting needs across performance areas.

Figure 8 shows the corridor need locations for each performance area and programmed projects for fiscal year (FY) 2016-2020. Programmed projects have not yet been constructed and may address identified needs or be modified as part of the development of strategic investments.

For additional detail on specific needs by location, refer to the information in Step 3.

9.1 Description of Needs by Performance Area

Pavement Needs

The Pavement Performance Area is not an emphasis area for SR 95. Four of 13 segments, 62.5 miles (37%), of the SR 95 corridor exhibit “Low” level of needs in Pavement Performance. These segments include:

- Segment 3 MP 43 - 60
- Segment 6 MP 104 - 111
- Segment 8 MP 131 - 142
- Segment 9 MP 142 - 149
- Segment 12 MP 176 - 190
- Segment 13 MP 190 – 202

Pavement hot spot failure needs were identified along the corridor, including areas that have levels of historical investment. Hot spots that will be addressed by a programmed project are not included.

- Hot Spots Failures
  - MP 131 - 132
  - MP 148 - 149
- Both Low PSR, and Composite scores
  - MP 104 – 105
  - MP 131 – 135
  - MP 137 – 140
  - MP 142 – 143
  - MP 177 – 179
  - MP 181 – 184
  - MP 189 – 190
- Low PDI, and Composite scores
  - MP 148 – 150
- MP 108 –111 and MP 42 –49 were observed to have medium level of investment with multiple mill and overlay projects and reconstruction.

Bridge Needs

The Bridge Performance Area is not an emphasis area for SR 95. Three of 13 segments of the SR 95 corridor exhibit “Medium” level of need in Bridge Performance. The segments include:

- Segment 3 MP 43 – 60
- Segment 8 MP 131 – 142
- Segment 12 MP 176 – 190

Three of 14 bridges exhibit high levels of historical bridge maintenance investment.

- Bouse Wash Bridge, MP 131.33
- Mocking Bird Wash Bridge, MP 178.26
- McCulloch Boulevard Underpass, MP 182.38

There are no programmed projects for existing bridges. However, the new Fortuna Wash Bridge is programmed and is under construction.

Key contributing factors/needs are summarized below

- McCulloch Boulevard Underpass, MP 182.38, has a deck rating of 5.
- Castle Dome Wash Bridge, MP 53.28, has an evaluation rating of 5
- Bouse Wash Bridge, at MP 131.33, has a Deck and Substructure rating of 5. This bridge is a candidates for life cycle cost analysis and risk assessment to evaluate alternatives ranging from continuing routine maintenance to bridge reconstruction.
- Mockingbird Wash Bridge, at 178.26, has a Deck and Substructure rating of 5. This bridge is a candidates for life cycle cost analysis and risk assessment to evaluate alternatives ranging from continuing routine maintenance to bridge reconstruction.

Mobility Needs

The Mobility Performance Area is an emphasis area for SR 95. All 13 segments of the SR 95 corridor exhibit need in Mobility Performance. There are no segments with Medium or High deficiencies. Segments include:

- Segment 1 MP 29 – 34
- Segment 2 MP 34 – 43
- Segment 3 MP 43 – 60
- Segment 4 MP 60 – 80
- Segment 5 MP 80 - 104
- Segment 6 MP 104 - 111
- Segment 7 MP 111 – 131
- Segment 8 MP 131 – 142
- Segment 9 MP 142 – 149
- Segment 10 MP 149 – 162
- Segment 11 MP 162 – 176
- Segment 12 MP 176 – 190
- Segment 13 MP 190 – 202

Mobility needs are summarized below that specify focus areas for the SR 95 corridor.

- The number of closures on SR 95 due to incidents/accidents or obstructions/hazards are above statewide average in the following areas:
    - MP 29 – 34 (incidents/accidents and obstructions/hazards)
    - MP 34 – 43 (obstructions/hazards)
    - MP 43 – 60 (obstructions/hazards)
    - MP 60 – 80 (incidents/accidents)
    - MP 80 – 104 (incidents/accidents and obstructions/hazards)
    - MP 111 – 131 (incidents/accidents and obstructions/hazards)
    - MP 131 – 142 (incidents/accidents and obstructions/hazards)
    - MP 142 – 149 (incidents/accidents and obstructions/hazards)
    - MP 149 – 162 (incidents/accidents and obstructions/hazards)
    - MP 162 – 176 (incidents/accidents)
    - MP 176 – 190 (incidents/accidents)
    - MP 190 – 202 (incidents/accidents and obstructions/hazards)

- Closures due to flooding have occurred in the following areas:
    - MP 29 – 34
    - MP 34 – 43
    - MP 43 – 60
    - MP 80 – 104
    - MP 111 – 131
    - MP 131 – 142

- Low trip reliability on the corridor occurs in the following areas which can be a result of limited passing lanes and closures:
    - NB MP 34 – 43
    - NB MP 60 – 80
    - SB MP 80 – 104
    - NB MP 104 – 111
    - NB MP 131 – 149
    - SB MP 162 – 176
    - MP 190 – 202

- Recurring congestion is high in the SB direction of MP 190 - 202

Safety Needs

The Safety Performance Area is an emphasis area for SR 95. Ten of 13 segments of the SR 95 corridor exhibit needs in Safety Performance. Seven of the 13 segments have Medium and High level of need. Safety needs by segment and the milepost of crash location are summarized below with the key characteristics that exceed statewide average.

- Segment 1 MP 29 – 30
    - Involved Left-Turn Crashes
    - Failure to Yield the Right-of-Way
    - Disregarded traffic Signal
    - Collision with Pedestrian

- Segment 2 MP 37 - 38
    - Involved Inattention/Distraction
    - Run Off the Road (Left)
    - Failure to Yield the Right-of-Way
    - Dark-Unlighted Conditions
    - Collision with Fixed Object

- Segment 4 MP 62 - 64
    - Involve Inattention/Distraction
    - Involve Overturning/Rollover
    - Single Vehicle Crashes

- Segment 5 MP 142, 144 – 146, MP 147
    - Angle and Left-Turn Crashes
    - Collision with Pedestrian
    - Disregarded Traffic Signal
    - Failure to Yield the Right-of-Way
    - Involved Crossing the Centerline

- Segment 6 MP 149 – 150, MP 153 – 155, MP 159
    - Involve Rear-End Collision
    - Involve Head-On Collision
    - Speed to Fast for Conditions
    - Failure to Keep in Proper Lane
    - Involve Collision with Fixed Object
    - Collision with Pedestrian

- Segment 11 MP 162 – 167, MP 172, MP 174 – 175
    - Involve Rear-End Collision
    - Involve Head-On Collision
    - Involve Inattention/Distraction
    - Dark-Unlighted Conditions

- Segment 12 MP 190 - 202
    - Angle and Left-Turn Crashes
    - Involve Inattention/Distraction
    - Involve Multi-Vehicle Collisions
    - Involve Overturning/Rollover

- Segment 13 MP 190 – 191, MP 195 – 197, MP 200 – 201
    - Involve Head-On Collision
    - Involve Angle crashes
    - Run Off the Road (Right)

Freight Needs

The Freight Performance Area is an emphasis area for SR 95. Twelve of 13 segments of the SR 95 corridor exhibit needs in Freight Performance. There are 10 segments with Medium and High level of need.

Similar to Mobility, road closures impact freight performance, these are summarized below that specify focus areas for the SR 95 corridor.

- The number of closures on SR 95 due to incidents/accidents or obstructions/hazards are above statewide average in the following areas:
    - MP 29 – 34 (incidents/accidents and obstructions/hazards)
    - MP 43 – 60 (obstructions/hazards)
    - MP 60 – 80 (incidents/accidents)
    - MP 80 – 104 (incidents/accidents and obstructions/hazards)
    - MP 111 – 131 (incidents/accidents and obstructions/hazards)
    - MP 131 – 142 (incidents/accidents and obstructions/hazards)
    - MP 142 – 149 (incidents/accidents and obstructions/hazards)
    - MP 149 – 162 (incidents/accidents and obstructions/hazards)
    - MP 162 – 176 (incidents/accidents)
    - MP 176 – 190 (incidents/accidents)
    - MP 190 – 202 (incidents/accidents and obstructions/hazards)

- Closures due to flooding have occurred in the following areas:
    - MP 29 – 34
    - MP 43 – 60
    - MP 80 – 104
    - MP 111 – 131
    - MP 131 – 142

- Low trip reliability on the corridor occurs in the following areas:
    - NB MP 34 – 43
    - MP 60 – 80
    - SB MP 80 – 104
    - SB MP 111 – 131
    - NB MP 131 – 149
    - MP 162 – 176
    - MP 190 – 202

Overlapping Needs

This section identifies overlapping performance needs on SR 95, which provides guidance to develop strategic solutions that address more than one performance area. Completing projects that address multiple needs may present the opportunity for cost savings as well as more effectively improving overall performance. The map in Figure 8 shows the extent of overlapping needs. Overlapping needs are summarized below.

- MP 130 -149 and MP 176 – 190 have overlapping needs in all five performance areas. The Bouse Wash Bridge, Mocking Bird Wash Bridge, and McCulloch Boulevard Underpass are within these areas that were identified as having a need. Low travel time reliability and road closures impact Mobility and Freight performance. Safety needs are attributed to angled and left-turn crashes, especially within MP 142 – 147.
- MP 104 – 111 have overlapping needs in the Safety, Pavement, Freight, and Mobility areas. Mobility and Freight are impacted by roadway closures and low travel time reliability.
- MP 29 – 43, MP 60 – 104 have overlapping needs in the Safety, Freight, and Mobility areas. The Safety needs may be attributed to access/intersection incidents. Mobility and Freight are impacted by roadway closures and low travel time reliability.
- MP 111 – 131 have overlapping needs in the Pavement, Freight, and Mobility areas. Mobility and Freight are impacted by roadway closures and low travel time reliability.
- MP 149 – 162 have overlapping needs in the Freight and Mobility areas. Mobility and Freight are impacted by roadway closures and low travel time reliability.

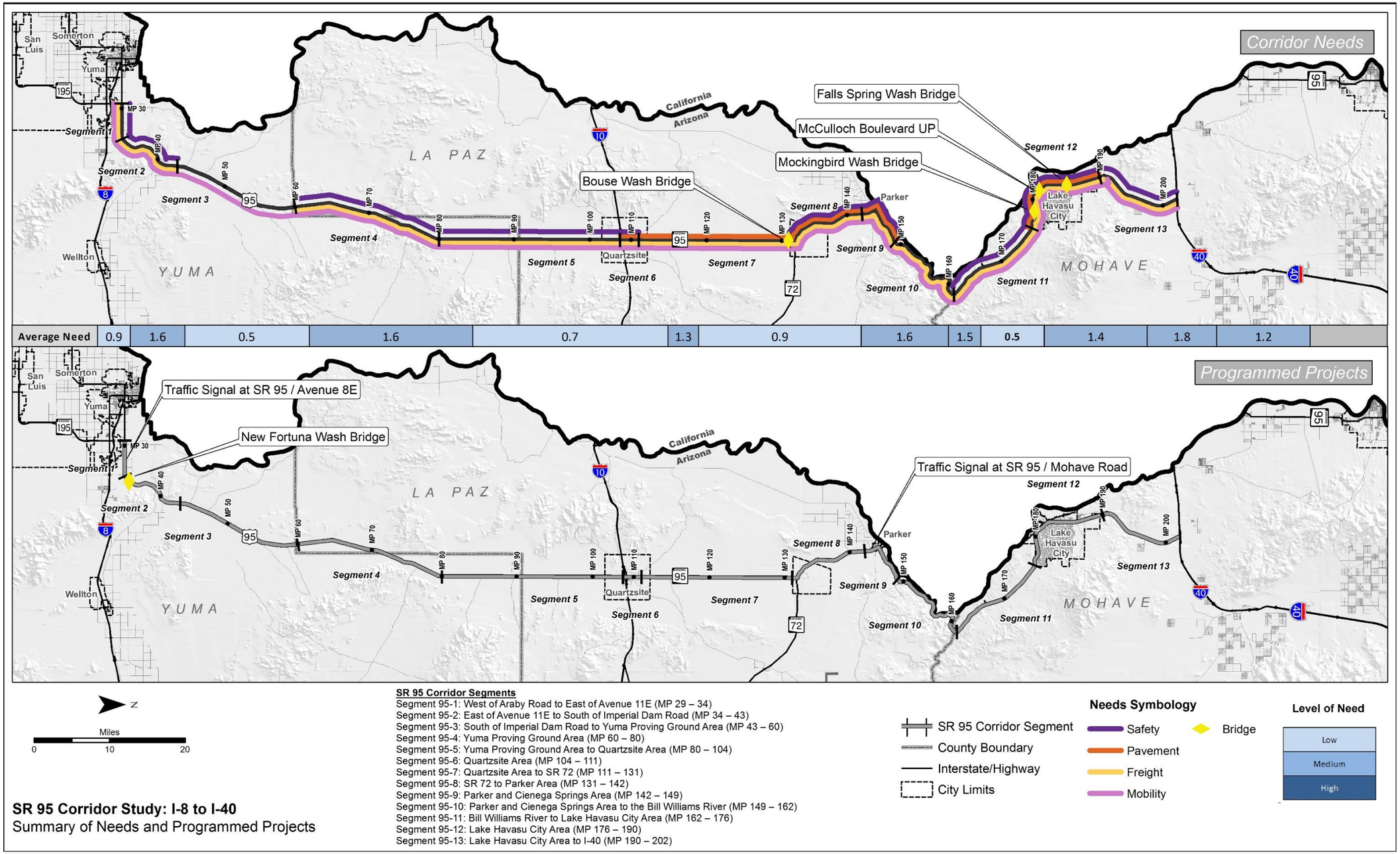


Figure 8: Summary of Needs and Programmed Projects (FY2016-2020)

10 Next Steps

The principal objective of the corridor profile study is to identify strategic solutions (investments) that are performance-based to ensure that available funds maximize the performance of the State's most strategic transportation corridors.

The actionable performance needs documented in Working Paper 4 will serve as a foundation for developing strategic investments for corridor preservation, modernization, and expansion. Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes where various candidate projects are developed for consideration in programming in the P2P Link process. Rather, strategic investments are intended to complement ADOT's traditional project development processes with non-traditional projects to address performance needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments will be considered along with other candidate projects in the ADOT programming process.

Illustrative examples of strategic investments are:

- *Projects that address significant performance needs.* Projects that address a Medium or High performance need identified in the corridor profile study that have a high probability to significantly improve corridor performance may be identified as strategic investments. These projects may include a project in the current program, a planned project not in the current program, or a new project recommended in the corridor profile study.
- *Projects that address needs in multiple performance areas.* For example, a single project to rehabilitate the roadway pavement surface and multiple bridge decks on a segment of roadway would address multiple performance areas (Pavement and Bridge) and could result in significant cost savings in traffic control (as compared to traffic control costs for separate projects to rehabilitate pavement surface and bridge decks). Another example would be that a travel lane pavement rehabilitation project could be expanded to include shoulder rehabilitation and rumble strip construction to reduce road departure safety needs.
- *Projects that address repetitive issues.* For example, if there is a history of high levels of maintenance activities at a particular bridge or segment of pavement, there may be an underlying need that, if addressed properly, will reduce the need for future maintenance. Higher-cost strategic capital investments to correct repetitive maintenance issues can result in life cycle cost savings by reducing maintenance costs over time.
- *Phased projects that achieve a long-term improvement objective.* For example, a life cycle cost analysis may recommend total pavement reconstruction to address a subgrade failure, however the cost of reconstruction may not be feasible from a funding perspective. A strategic investment may be recommended to extend the life of the current pavement infrastructure until funding availability allows for full pavement reconstruction.
- *Projects that utilized innovative solutions to extend the operational life of infrastructure or improve performance.* Innovative solutions that modernize a segment of roadway may be identified as strategic investments. Examples of modernization activities include widening of shoulders, access control, replacement/enhancement of infrastructure to address obsolescence, hazard elimination, and the application of various traffic control and management technologies to improve traffic flow at a lower cost than traditional expansion solutions.

Strategic investments will be developed in Task 5 of the corridor profile study in collaboration with the Technical Advisory Committee to address specific performance needs on SR 95. In addition, meetings will be conducted with ADOT staff to discuss alternatives for addressing infrastructure performance needs that can be evaluated through a systematic analysis of life cycle costs and risks.

APPENDIX: Methodologies for Determining Performance Area Deficiencies (Steps 1-3)

Pavement Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Pavement Performance Area. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The Step 1 example is illustrated in **Table 1** for the I-17 corridor.

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Pavement. As each performance score is input into the template, the Initial Need (Column P) will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template (Table 1).

To develop an aggregate Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Facility Type".

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate "Performance Score" columns (columns E, H, I, and M). Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Pavement is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 (Column D). The Step 2 example is illustrated in **Table 2** for the I-17 corridor.

The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the segment information and the initial needs from the Step 1 template to the "Initial Need" column (column D) of the Step 2 template.

Step 2.2

Note in the "Hot Spots" column (column E) any pavement failure hot spots identified as part of the baseline corridor performance. For each entry, include the milepost limits of the hot spot. Hot spots are identified in the Pavement Index spreadsheet by the red cells in the columns titled "% Pavement Failure". These locations are based on the following criteria:

Interstates: IRI > 105 or Cracking > 15

Non-Interstates: IRI > 142 or Cracking > 15

Every segment that has a % Pavement Failure greater than 0% will have at least one hot spot. Hot spot locations should be described as extending over consecutive miles. For example, if there is a pavement failure location that extends 5 consecutive miles, it should be identified as one hot spot, not 5 separate hot spots.

Step 2.3

Identify recently completed or under construction paving projects in the "Previous Projects" column (column F). Include only projects that were completed after the pavement condition data period (check dates in pavement condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.5

Update the "Final Need" column (column G) using the following criteria:

- If "None" but have a hot spot (or hot spots), the Final Need = Low, and note the reason for the change in the "Comments" column (column H).

- If a recent project (Column F) has superseded the performance rating data, change the Final Need to “None” and note the reason for the change in the “Comments” column (column H).

Step 2.6

Note any programmed projects that could have the potential to mitigate pavement needs in in the “Comments” column (column H). Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the “Comments” column (column H). However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Table 1 - Step 1 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							NB	SB		NB	SB				
17-1	7	215 - 222	Interstate	4.19	Fair or Better	None	4.24	4.14	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-2	10	222 - 232	Interstate	4.16	Fair or Better	None	4.13	4.15	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-3	13	232 - 245	Interstate	3.85	Fair or Better	None	3.92	3.86	Fair or Better	None	None	3.80%	Fair or Better	None	None
17-4	8	245 - 253	Interstate	4.25	Fair or Better	None	3.65	4.25	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-5	10	253 - 263	Interstate	4.25	Fair or Better	None	4.09	4.02	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-6	16	263 - 279	Interstate	4.26	Fair or Better	None	4.08	4.02	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-7	9	279 - 288	Interstate	3.92	Fair or Better	None	3.78	3.93	Fair or Better	None	None	16.70%	Fair or Better	Medium	Low
17-8	11	288 - 299	Interstate	4.32	Fair or Better	None	4.01	4.17	Fair or Better	None	None	4.50%	Fair or Better	None	None
17-9	8	299 - 307	Interstate	4.21	Fair or Better	None	3.77	4.18	Fair or Better	None	None	18.80%	Fair or Better	Medium	Low
17-10	9	307 - 316	Interstate	4.19	Fair or Better	None	4.01	4.06	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-11	7	316-323	Interstate	3.73	Fair or Better	None	3.50	3.82	Fair or Better	Low	None	21.40%	Fair or Better	Medium	Low
17-12	17	323-340	Interstate	3.70	Fair or Better	None	3.49	3.82	Fair or Better	Low	None	25.70%	Fair or Better	High	Low
Emphasis Area?	No	Weighted Average		4.07	Fair or Better	None									

Pavement Index Performance Thresholds	Level of Need		Description
3.75	Good	None	All of Good Performance and upper 1/3rd of Fair Performance
	Good		
	Good		
	Fair		
	Fair	Low	Middle 1/3rd of Fair Performance
3.2	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
	Poor		
	Poor	High	Lower 2/3rd of Poor Performance
	Poor		

Needs Assessment Scale for Interstates

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.57	3.38	3.38	3.02	3.02
Pavement Index (corridor emphasis area)	3.93	3.57	3.57	3.20	3.20
Pavement Index (segments)	3.57	3.38	3.38	3.02	3.02
Directional PSR	3.57	3.38	3.38	3.02	3.02
%Pavement Failure	10%	15%	15%	25%	25%

Table 2 - Step 2 Examples

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments		Final Need	Comments (may include programmed projects or issues from previous reports)
				Hot Spots	Previous Projects (which supersede condition data)		
17-1	7	215 - 222	None	-	-	None	Recent projects repaved this area with PCCP
17-2	10	222 - 232	None	-	-	None	Recent projects repaved this area with PCCP
17-3	13	232 - 245	None	NB MP 236-237	-	Low	Presence of Hotspot elevated Need from None to Low; Project is programmed in FY 17
17-4	8	245 - 253	None	-	-	None	
17-5	10	253 - 263	None	-	-	None	
17-6	16	263 - 279	None	-	-	None	
17-7	9	279 - 288	Low	NB MP 281-282 and 286-287, SB MP 281-282	Pavement preservation project is currently under construction	None	Project is currently under construction so need was eliminated
17-8	11	288 - 299	None	NB MP 289-290	Pavement preservation project is currently under construction	None	Project is currently under construction so need was eliminated
17-9	8	299 - 307	Low	NB MP 302-305	Recent pavement preservation project	None	Final DCR (2012) stated that the most severe cracks were located in NB near MP 301. Need eliminated due to recent preservation project
17-10	9	307 - 316	None	-	-	None	
17-11	7	316-323	Low	NB MP 316-317 and 320-322	-	Low	
17-12	17	323-340	Low	NB MP 326-327, 328-330, 332-334, 339-340, and SB MP 339-340	-	Low	Project is programmed in FY 19

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab (Column D). The Step 3 example is illustrated in **Table 3** for the I-17 corridor.

The steps to complete Step 3 include:

Step 3.1

Input the level of historical investment for each segment. This will be determined from the numeric score from the Pavement History Table based on the following thresholds:

- Low = < 4.60
- Medium = 4.60 – 6.60
- High = > 6.60

If the PECOS data shows a high level of maintenance investment, increase the historical investment rating by one level.

Step 3.2

Note the milepost ranges of pavement failure hot spots into the column titled “Contributing Factors and Comments” (column F)

Step 3.3

Note any other information that may be contributing to the deficiency, or supplemental information, in the “Contributing Factors and Comments” column (column F). This could come from discussions with ADOT District staff, ADOT Materials/Pavement Group, previous reports, or the historical investment data.

Step 3.4

Include any programmed projects from ADOT’s 5-year construction program in the “Contributing Factors and Comments” column (column F)

Table 3 - Step 3 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Historical Investment	Contributing Factors and Comments
17-1	7	215 - 222	None	High	
17-2	10	222 - 232	None	High	
17-3	13	232 - 245	Low	Medium	Failure hot spot on NB (MP 236-237); Project is programmed in FY 17 (MP 232-240); should mitigate issues
17-4	8	245 - 253	None	Medium	
17-5	10	253 - 263	None	Medium	
17-6	16	263 - 279	None	Low	
17-7	9	279 - 288	None	Medium	
17-8	11	288 - 299	None	High	
17-9	8	299 - 307	None	High	
17-10	9	307 - 316	None	Medium	
17-11	7	316-323	Low	Low	Issues likely due to lack of recent investment; Failure hotspots on NB MP 316-317 and 320-322
17-12	17	323-340	Low	High	Several miles of failure (25% of segment); pavement failing with high level of previous investment; lower performance on NB than on SB; According to Flagstaff District, NB MP 334 to 337 center line is unraveling due to not being treating by leveling micro-seal treatment, and SB was placed on concrete and the concrete is failing

Pavement Historical Investment Methodology

ADOT provided pavement rehabilitation project data for the last 20 years which was used to estimate the level of previous investment in each segment.

The historical project data for I-40 is shown in **Table 4**. Each project is represented by a rectangular shape that is drawn to show the milepost limits of the project. In addition, the height of the shape indicates whether the project included either both directions (bi-directional) or a single direction (uni-directional). The shapes that are thinner represent uni-directional projects while the thicker shapes represent bi-directional projects. Each shape contains the year the project was constructed, the project TRACS number, indicates which directions were paved, and includes a brief description of the project.

Each project was categorized (and shaded) as follows:

- New paving or full reconstruction
- Mill and overlay (with additional structural section)
- Mill and overlay (no change in structural section)
- Fog coat or overlay treatments

The darker shade represents the highest levels of investment (new paving or full reconstruction) while the lightest shade represents the lowest level of investment (fog coat or overlay treatment). Projects that include asphalt concrete pavement have a black border while projects that include PCCP have a dashed orange border.

To estimate the level of previous investment, an approximate weighting was applied to each of the four project categories as follows:

- Fog coat or overlay treatments; typical cost of approximately $3/SY to $6/SY (use an average of $5/SY and a cost level weight = 1)
- Mill and overlay (no change in structural section); cost level weight = 3 (based on middle range between 1 and 6)
- Mill and overlay (with additional structural section); cost level weight = 4 (based on middle range between 1 and 6)
- New paving or full reconstruction; typical cost of approximately $25/SY to $45/SY (use an average of $30/SY and a cost level weight = 6)

The process to estimate the level of previous investment included three steps:

1. Estimate the percent coverage of each project relative to segment length
2. Multiply the percent coverage of each project times the cost level weight based on the project category
3. Sum all of the results to estimate the level of previous investment for each segment (the uni-directional projects were divided by two such that they are only one direction)

Table 5 shows this process for the I-40 corridor.

The results for the I-17, I-19, and I-40 corridors were used to determine thresholds for the levels of previous investment. The results ranged from 1.75 to 11.2 with an average (mean) of 5.1.

The Standard score (z-score) was calculated for all segments. The Standard score (z-score) is the number of standard deviations above or below the mean. Therefore, a Standard score between -0.5 and +0.5 is “average”, less than -0.5 is lower (better) than average, and higher than +0.5 is above (worse) average. The resulting Standard scores indicated that the historical level of investment can be classified as either “Low”, “Medium”, or “High” based on the following criteria:

- < 4.60 = "Low"
- 4.60 - 6.60 = "Medium"
- > 6.60 = "High"

Table 4 – Pavement History Example

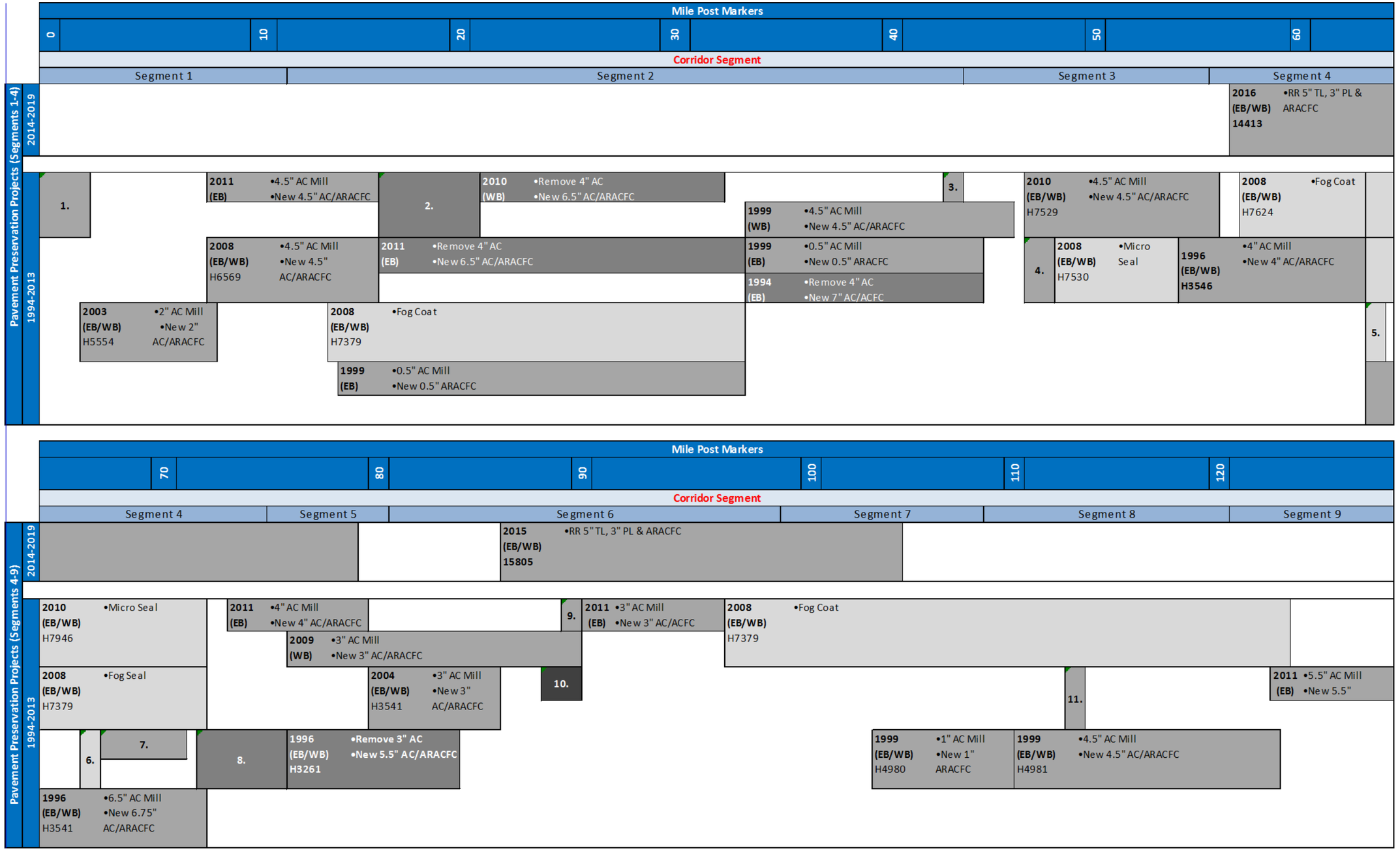
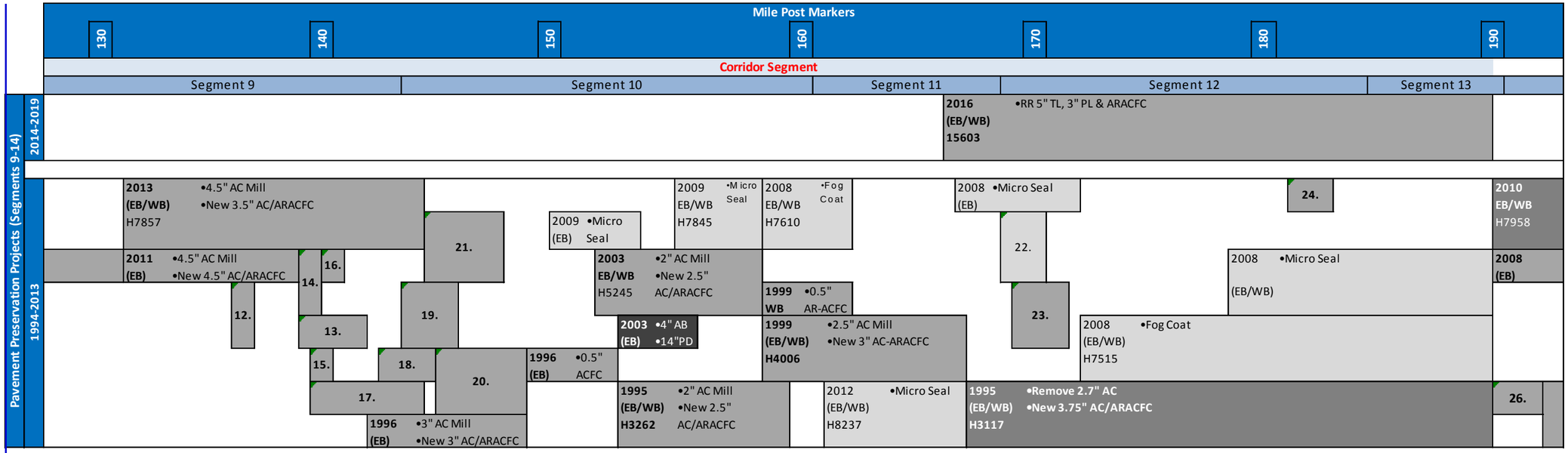
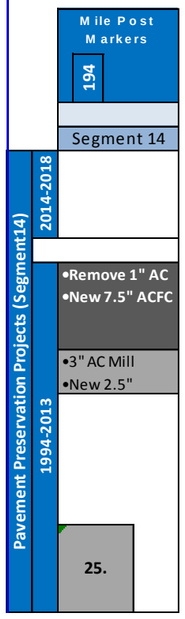


Table 4 - Pavement History Example (Continued)





Pavement Treatment Reference Numbers

1. **2012 (EB/WB)** H7663: 4.5" AC Mill, New 4.5" AC/ARACFC
2. **2008 (EB/WB)** H6569: Remove 4.5" AC, New 6.5" AC/ARACFC
3. **1999 (WB)** H7568: 3" AC Mill, New 3" AC/ACFC
4. **2005 (EB/WB)** H6622: 3" AC Mill, New 3" AC/ARACFC
5. **2008 (EB/WB)** H7535: Micro Seal
6. **2008 (EB/WB)** H7531: Double Chip Seal
7. **2003 (WB)** H5525: 2.5" AC Mill, New 3" AC/ARACFC
8. **1996 (EB/WB)** H32610: Remove 3" AC, New 5.5" AC/ARACFC
9. **1996 (EB)** H7568: Remove 3" AC, New 3" AC/ACFC
10. **2003 (EB)** H4583: New 6" AB, 12.5" AC/ARACFC
11. **2009 (EB/WB)** H7568: 4.5" AC Mill, New 4.5" AC/ACFC
12. **2003 (EB/WB)** H6265: 3" AC Mill, New 3" AC
13. **1999 (EB)** H3908: Remove 3.25" AC, New 6.25" AC/ARACFC
14. **2003 (EB/WB)** H6266: 4" AC Mill, New 4" AC
15. **1999 (WB)** H3908: Remove 3.25" AC, New 6.5" AC/ARACFC
16. **2003 (WB)** H6266: 3" AC Mill, New 3" AC/ARACFC
17. **2003 (WB)** H3908: Remove 2.5" AC, New 5.5" AC/ARACFC
18. **1999 (EB)** H3908: Remove 3.25" AC, New 6" AC/ARACFC
19. **1999 (EB/WB)** H6833: Remove 2.5" AC, New 4.5" AC/ARACFC
20. **1996 (EB/WB)** H3612: 2" AC Mill, New 2" AC/ARACFC
21. **2009 (EB/WB)** H6833: Remove 2.5" AC, New 4.0" AC/ARACFC
22. **2009 (EB/WB)** H7845: Micro Seal
23. **2006 (EB/WB)** H6888: 2.5" AC Mill, New 2.5" AC, Fog Coat
24. **2013 (EB/WB)** H8541: 2.5" AC Mill, New 2.5" AC
25. **1996 (EB/WB)** H3263: 2" AC Mill, New 2.5" AR/ARACFC
26. **1996 (WB)** H3263: 3" AC Mill, New 3.5" AR/ARACFC

Legend

- New Paving or Reconstruction
- Mill and Overlay (Adding Structural Thickness)
- Mill and Replace (No Change Structural Thickness)
- Fog Coat or Thin Overlay Treatments
- PCCP Pavement Border
- AC Pavement Border

Table 5 – Calculation of Historical Investment Example

Cost Value	Level	I-40 Segment Number																									
		1		2		3		4		5		6		7		8		9		10		11		12		13		14	
		Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir
1	L1				60%		50%		25%				15%		100%		100%		15%	25%	20%	25%	20%	20%	10%		90%		
1									50%												10%		75%		80%		90%		
1									50%																40%				
1									5%																				
1																													
3	L2	30%	20%	15%	15%	20%	75%	20%	35%	90%	15%	30%	50%		55%		10%	45%	10%	10%	5%	20%	80%	10%	15%	10%		100%	60%
3			60%	60%	35%	10%	10%	10%	50%	90%		5%					10%	30%	50%	5%	15%					10%		25%	
3			30%	5%			10%					30%					90%	15%	5%	35%	25%								
3																		20%	5%	25%	50%								
3																		20%		10%	50%								
4	L3			50%	15%	10%			15%		80%		20%										20%		100%		90%		100%
4				40%																							10%		
4				35%																									
4																													
4																													
6	L4											10%								20%									
6																													
6																													
6																													
6																													
Sub-Total		0.9	3.3	7.4	2.7	1.3	3.35	0.9	4.45	5.4	3.65	2.55	2.45	0	2.65	0	4.3	3.9	2.25	4	4.65	0.85	4.15	0.5	5.75	0.6	5.8	3.75	5.8
Total		**3.75**		**6.4**		**4**		**4.9**		**6.35**		**3.725**		**2.65**		**4.3**		**4.2**		**6.65**		**4.575**		**6**		**6.1**		**7.675**	

Bridge Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Bridge Performance Area. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The Step 1 sample template is illustrated in **Table 1** for the I-17 corridor.

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Bridge. As each performance score is input into the template, the Initial Need (Column Q) will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template (Table 1).

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Deficiency for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Number of Bridges".

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate "Performance Score" columns (columns E, H, K, and N). Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Bridge is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 (Column E). The Step 2 sample template is illustrated in **Table 2** for the I-17 corridor.

The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the "Initial Need" column (column E) of the Step 2 template.

Step 2.2

Note in the column titled "Hot Spots" (Column F) any bridge hot spots identified as part of the baseline corridor performance. For each entry, note the specific location. Hot spots are identified as having any bridge rating of 4 or less, or multiple ratings of 5 in the deck, substructure, or superstructure ratings.

Step 2.3

Identify recently completed or under construction bridge projects in the "Previous Projects" column (column G). Include only projects that were completed after the bridge condition data period (check dates in bridge condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.4

Update the Final Need (column H) on each segment based on the following criteria:

- If the Initial Need is "None" and there is at least one hot spot located on the segment, change the Final Need to "Low".
- If a recent project (Column G) has superseded the performance rating data, the performance data should be adjusted to increase the specific ratings and the resulting need should be reduced to account for the project.
- Note the reason for any change in the "Comments" column (Column K).

Step 2.5

Historical bridge rating data was tabulated and graphed to find any bridges that had fluctuations in the ratings. Note in the "Historical Review" column (Column I) any bridge that was identified as having a potential historical rating concern based on the following criteria:

- Ratings increase or decrease (bar chart) more than 2 times
- Sufficiency rating drops more than 20 points

This is for information only and does not affect the level of need.

Step 2.6

Note the number of functionally obsolete bridges in each segment in the column titled “# Functionally Obsolete Bridges” (Column J). This is for information only and does not affect the level of need.

Step 2.7

Identify each bridge “of concern” in the “Comments” column (Column K). Note any programmed projects that could have the potential to mitigate bridge deficiencies in Column K. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the “Comments” column (Column K). However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Table 1 - Step 1 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
17-1	7	215 - 222	13	6.76	Fair or Better	None	5	Fair or Better	Low	91.0	Fair or Better	None	31.1%	Fair or Better	Medium	Low
17-2	10	222 - 232	11	6.79	Fair or Better	None	6	Fair or Better	None	92.7	Fair or Better	None	14.6%	Fair or Better	None	None
17-3	13	232 - 245	15	6.39	Fair or Better	None	5	Fair or Better	Low	91.1	Fair or Better	None	31.3%	Fair or Better	Medium	Low
17-4	8	245 - 253	4	5.71	Fair or Better	Low	5	Fair or Better	Low	94.0	Fair or Better	None	60.9%	Fair or Better	High	Medium
17-5	10	253 - 263	10	7.25	Fair or Better	None	6	Fair or Better	None	96.4	Fair or Better	None	15.0%	Fair or Better	None	None
17-6	16	263 - 279	10	6.19	Fair or Better	None	5	Fair or Better	Low	94.8	Fair or Better	None	8.5%	Fair or Better	None	Low
17-7	9	279 - 288	5	6.31	Fair or Better	None	6	Fair or Better	None	91.4	Fair or Better	None	0.0%	Fair or Better	None	None
17-8	11	288 - 299	7	6.04	Fair or Better	None	4	Fair or Better	Medium	89.2	Fair or Better	None	13.6%	Fair or Better	None	Low
17-9	8	299 - 307	2	6.00	Fair or Better	None	6	Fair or Better	None	93.0	Fair or Better	None	100.0%	Fair or Better	High	Low
17-10	9	307 - 316	2	6.52	Fair or Better	None	6	Fair or Better	None	94.0	Fair or Better	None	100.0%	Fair or Better	High	Low
17-11	7	316 - 323	9	6.91	Fair or Better	None	5	Fair or Better	Low	96.5	Fair or Better	None	3.4%	Fair or Better	None	Low
17-12	17	323-340	10	5.80	Fair or Better	Low	5	Fair or Better	Low	92.0	Fair or Better	None	62.3%	Fair or Better	High	Medium
Emphasis Area?	No	Weighted Avg		6.34	Fair or Better	None										

Bridge Index Performance Thresholds	Level of Deficiency		Description
6.5	Good	None	All of Good Performance and upper 1/3rd of Fair Performance
	Good		
	Good		
	Fair		
	Fair	Low	Middle 1/3rd of Fair Performance
5.0	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
	Poor		
	Poor	High	Lower 2/3rd of Poor Performance
	Poor		

Needs Assessment Scale

Measure	None >=	Low >=	> Medium <		High <=
Bridge Index (corridor non-emphasis area)	6.0	5.5	5.5	4.5	4.5
Bridge Index (corridor emphasis area)	7.0	6.0	6.0	5.0	5.0
Bridge Index (segments)	6.0	5.5	5.5	4.5	4.5
Bridge Sufficiency	70	60	60	40	40
Bridge Rating	6.0	5.0	4.0	4.0	3.0
%Functionally Obsolete Bridges	21.0%	31.0%	31.0%	49.0%	49.0%

Table 2 - Step 2 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
17-1	7	215 - 222	13	Low	-	-	Low	-	6	Pinnacle Peak TI and Happy Valley TI; Both of these bridges were identified for replacement in Final DCR (2004); Likely to be programmed in future MAG update
17-2	10	222 - 232	11	None	-	-	None	-	1	No bridges with current ratings of 4 or 5 and no historical issues
17-3	13	232 - 245	15	Low	Moores Gulch SB	-	Low	Moores Gulch SB	7	Moores Gulch SB and Little Squaw Creek NB; Little Squaw Creek NB was identified as Structurally Deficient in Final DCR (2004); Moores Gulch SB programmed in FY 17
17-4	8	245 - 253	4	Medium	-	-	Medium	-	2	Bumble Bee TI NB
17-5	10	253 - 263	10	None	-	-	None	-	4	No bridges with current ratings of 4 or 5 and no historical issues
17-6	16	263 - 279	10	Low	SR 169 TI	-	Low	Dugas Rd TI and Ceinga Creek NB	2	Ash Creek SB, SR 169 TI, Dugas Rd TI SB, Ceinga Creek NB
17-7	9	279 - 288	5	None	-	-	None	-	0	No bridges with current ratings of 4 or 5 and no historical issues
17-8	11	288 - 299	7	Low	McGuireville TI, SR 179 TI SB	-	Low	McGuireville TI, Middle Verde Rd TI, and Dry Beaver Creek SB	2	McGuireville TI, Middle Verde TI, Dry Beaver Creek SB, SR 179 TI SB; McGuireville TI programmed in FY 15
17-9	8	299 - 307	2	Low	-	-	Low	-	2	No bridges with current ratings of 4 or 5 and no historical issues
17-10	9	307 - 316	2	Low	-	-	Low	-	2	No bridges with current ratings of 4 or 5 and no historical issues
17-11	7	316 - 323	9	Low	-	-	Low	-	2	Woods Canyon TI (Fox Ranch Rd TI)

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab (Column F). The Step 3 sample template is illustrated in **Table 3** for the I-17 corridor.

The steps to compete Step 3 include:

Step 3.1

Input the bridge name, structure number, and milepost into Column G for each bridge "of concern" resulting from Step 2.

Step 3.2

For bridges that have a current rating of 5 or less, enter the specific rating in Column H, or state "No current ratings less than 6".

Step 3.3

For bridges that were identified for a historical review (step 2.5), state "Could have a repetitive investment issue" in Column I. If a bridge was not identified for a historical review, state "This structure was not identified in historical review".

Step 3.4

Input any programmed projects from ADOT's 5-year construction program into Column J. Note any other information that may be contributing to the deficiency, or supplemental information, in Column J. This could come from discussions with ADOT District staff, ADOT Bridge Group, or previous reports.

Table 3 - Step 3 Example

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
17-1	7	215 - 222	13	6	Low	**Pinnacle Peak TI (#821)(MP 217.10)**	Current Deck Rating of 5	This structure was not identified in historical review	Likely to be replaced to facilitate mainline widening; will be included in updated MAG program; currently in DCR phase
						Happy Valley TI (#822)(MP 218.01)	Current Deck Rating of 5	This structure was not identified in historical review	
17-2	10	222 - 232	11	1	None	No bridges with current ratings less than 6 and no historical issues			
17-3	13	232 - 245	15	7	Low	**Moores Gulch SB (#339)(MP 238.60)**	Current Deck and Superstructure ratings of 5	Could have a repetitive investment issue	Project is programmed in FY 17
						Little Squaw Creek NB (#968)(MP 239.20)	Current Deck Rating of 5	This structure was not identified in historical review	
17-4	8	245 - 253	4	2	Medium	**Bumble Bee TI NB (#1171)(MP 248.40)**	Current Deck Rating of 5	This structure was not identified in historical review	
17-5	10	253 - 263	10	4	None	No bridges with current ratings less than 6 and no historical issues			
17-6	16	263 - 279	10	2	Low	**Dugas Rd TI SB (#1080)(MP 268.75)**	No Current Ratings less than 6	Could have a repetitive investment issue	
						Ash Creek SB (#389)(MP 269.11)	Current Structural Evaluation Rating of 5	This structure was not identified in historical review	
						Ceinga Creek NB (#428)(MP 277.93)	Current Substructure Rating of 5	Could have a repetitive investment issue	
						SR 169 TI (#1734)(MP 278.40)	Current Deck and Superstructure Ratings of 5	This structure was not identified in historical review	
17-7	9	279 - 288	5	0	None	No bridges with current ratings less than 6 and no historical issues			
17-8	11	288 - 299	7	2	Low	**Middle Verde Rd TI (#1733)(MP 289.97)**	No Current Ratings less than 6	Could have a repetitive investment issue	
						McGuireville TI (#652)(MP 293.26)	Current Superstructure Rating of 4	Could have a repetitive investment issue	Project in programmed in FY 15
						Dry Beaver Creek SB (#654)(MP 293.40)	No Current Ratings less than 6	Could have a repetitive investment issue	
						SR 179 TI SB (#1061)(MP 298.96)	Current Deck and Substructure Ratings of 5	This structure was not identified in historical review	
17-9	8	299 - 307	2	2	Low	No bridges with current ratings less than 6 and no historical issues			Due to # of functionally obsolete bridges
17-10	9	307 - 316	2	2	Low	No bridges with current ratings less than 6 and no historical issues			Due to # of functionally obsolete bridges

Mobility Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Mobility Performance Area. The 5-step process is listed below. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of deficiency that combines all performance areas. Corridor deficiencies are then translated to needs in Step 5 of the process in order to identify needs by type and overlapping needs throughout the corridor.

- Step 1: Initial Deficiencies
- Step 2: Refined Deficiencies
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Deficiencies

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns from Task 2/Working Paper #2. This includes the primary and secondary measures for Mobility. As each performance score is input into the template, the Initial Need (Column/Row S/33) will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" in the Step 1 tab.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Input the accurate number of segments for your corridor in the column titled 'Segment' and the appropriate segment milepost limits and segment lengths in adjacent columns (Columns A-C).

Step 1.2

Select the appropriate 'Environment Type' and 'Facility Operation Type' from the drop down menus as defined in Task 2 - Existing Performance Analysis (Columns D and E).

Step 1.3

Select 'Yes' or 'No' form the drop down list to not if the Mobility Performance Area is an Emphasis Area for your corridor in cell C30.

Step 1.4

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/Working Paper #2. Copy the performance score for each segment to the appropriate "Performance Score" column. PASTE VALUES ONLY.

Step 1.5

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

The step 1 template and scales for the mobility index are illustrated below for the I-19 corridor.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 (Column D). The Step 2 sample template is illustrated in **Table 2** for the I-19 corridor.

The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial deficiencies from the Step 1 template to Column D of the Step 2 template.

Step 2.2

Identify recently completed or under construction projects (Column E&F) that would be considered relevant to mobility performance. Include only projects that were constructed after 2014 for which the 2014 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2014 that has the potential to mitigate a mobility issue on a corridor segment should be listed in the template. Such projects should include the construction of new travel lanes or speed limit changes on the main corridor only. Do not include projects involving frontage roads or crossings as they would not impact the corridor level performance.

Step 2.3

Update the Final Need (Column G) using the following criteria:

- If a recent project (Column E&F) has superseded the performance rating data and it is certain the project addressed the deficiency, change the deficiency rating to "None".
- If a recent project (Column E&F) has superseded the performance rating data but it is uncertain that a project addressed the deficiency, maintain the current deficiency rating and note the uncertainty as a comment in Column H.

Step 2.5

Note any programmed or planned projects that have the potential to mitigate any mobility deficiency on the segment in Column H. Programmed and Planned projects are provided as information and do not impact the deficiency rating. Future projects will be reviewed in the development of solution sets for identified needs and deficiencies. The source of future projects can be found in ADOT's 5-year construction program or other planning documents. Other comments relevant to the needs analysis can be entered in the right-most column (Column H).

Table 1 - Step 1 Example

Mobility

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											NB	SB		NB	SB	NB	SB		NB	SB
19-1	0-3	3	Urban	Uninterrupted	0.22	Fair or Better	None	0.27	Fair or Better	None	0.14	0.14	Fair or Better	None	None	0.27	0.27	Fair or Better	None	None
19-2	3-18	15	Rural	Uninterrupted	0.40	Fair or Better	None	0.49	Fair or Better	None	0.25	0.26	Fair or Better	None	None	0.30	0.20	Fair or Better	None	None
19-3	18-30	12	Rural	Interrupted	0.32	Fair or Better	None	0.39	Fair or Better	None	0.19	0.20	Fair or Better	None	None	0.11	0.19	Fair or Better	None	None
19-4	30-40	9	Urban	Uninterrupted	0.41	Fair or Better	None	0.50	Fair or Better	None	0.24	0.25	Fair or Better	None	None	0.25	0.20	Fair or Better	None	None
19-5	40-57	18	Urban	Uninterrupted	0.69	Fair or Better	None	0.81	Fair or Better	Low	0.46	0.44	Fair or Better	None	None	0.29	0.23	Fair or Better	None	None
19-6	57-64	7	Urban	Uninterrupted	1.32	Fair or Better	High	1.59	Fair or Better	High	0.87	0.74	Fair or Better	Medium	None	0.31	0.34	Fair or Better	None	None
Mobility Emphasis Area		Yes	Weighted Average		0.56	Good	None													

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional TTI (all vehicles)					Directional PTI (all vehicles)					Bicycle Accomodation			Initial Level of Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					NB	SB		NB	SB	NB	SB		NB	SB				
19-1	0-3	3	Urban	Uninterrupted	1.40	1.01	Fair or Better	High	None	2.28	1.30	Fair or Better	High	None	100%	Fair or Better	None	Low
19-2	3-18	15	Rural	Uninterrupted	1.16	1.13	Fair or Better	None	None	1.25	1.22	Fair or Better	None	None	100%	Fair or Better	None	None
19-3	18-30	12	Rural	Interrupted	1.58	1.10	Fair or Better	Low	None	2.50	1.17	Fair or Better	None	None	100%	Fair or Better	None	Low
19-4	30-40	9	Urban	Uninterrupted	1.06	1.06	Fair or Better	None	None	1.08	1.12	Fair or Better	None	None	100%	Fair or Better	None	None
19-5	40-57	18	Urban	Uninterrupted	1.06	1.08	Fair or Better	None	None	1.11	1.15	Fair or Better	None	None	100%	Fair or Better	None	Low
19-6	57-64	7	Urban	Uninterrupted	1.00	1.04	Fair or Better	None	None	1.03	1.14	Fair or Better	None	None	100%	Fair or Better	None	High

Example Scales for Level of Need

Performance Thresholds	Initial Need	Description
0.71	None	(<0.77)
	Low	Middle 1/3rd of Fair Perf. (0.77 - 0.83)
0.89	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (0.83-0.95)
	High	Lower 2/3rd of Poor Performance (>0.95)

NOTE: The value of the 1/3 sections was defined by the range of the "fair" rating.
In this example, each 1/3 section has a value of 0.06. [(0.89-0.71)/3=0.06].

Example Scale for Corridor Average Mobility Index if Mobility is Emphasis Area

Performance Thresholds	Initial Need	Description
0.71	None	(<0.65)
	Low	Lower 1/3 of Good and Upper 1/3 of Fair Performance (0.65 - 0.77)
0.89	Medium	Middle 1/3 and Lower 1/3 of Fair Perf. (0.77 - 0.89)
	High	(>0.89)

Scale

Measure		None <=	Low >=	> Medium <		High <=
Mobility Index (Corridor Emphasis Area)		0.58	0.71	0.71	0.84	0.84
Mobility Index (Corridor Non-Emphasis Area)		0.71	0.77	0.77	0.90	0.90
Mobility Index (Segment)	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Future Daily V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Existing Peak hour V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Closure Extent		0.74	1.10	1.10	1.82	1.82
Directional TTI	Uninterrupted	1.21	1.27	1.27	1.39	1.39
	Interrupted	1.53	1.77	1.77	2.23	2.23
Directional PTI	Uninterrupted	1.37	1.43	1.43	1.57	1.57
	Interrupted	2.67	3.33	3.33	4.67	4.67
Bicycle Accomodation		80%	70%	70%	50%	50%

Table 2 - Step 2 Example

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2013	Final Need	Planned and Programmed Future Projects
19-1	0-3	3	Low	None	Low	Planned I-19, I-19B Terminus to West Street - Roadway Improvements for Future Capacity I-19 and Mariposa TI reconfiguration
19-2	3-18	15	None	None	None	Planned I-19, SR 189/Mariposa Road TI to Tumacocori TI – Roadway Improvements for Future Capacity I-19, Exit 22 (Peck Canyon Rd) to Exit 48 (Arivaca Road) – Interchange Improvements I-19 Safety Corridor Improvements MP 8.4 - 9.4
19-3	18-30	12	Low	None	Low	Programmed (FY 2015) Canoa Shooulders - Construct Shoulder Widening
19-4	30-40	9	None	None	None	Nothing planned or programmed in this segment
19-5	40-57	18	Low	None	Low	Planned Esperanza, Duval Mine Rd, Helmet Peak, Pima Mine Rd, Papago TI reconstruction projects listed in various planning documents Widen to six lanes MP 39 - 58 in PAG 2040 RTP
19-6	57-64	7	High	None	High	Programmed Ajo Way TI - Reconstruct TI and Mainline (2015, 2018) Irvington Road and I-19 – Design and reconstruct new TI (SPUI) Planned Capacity expansion planned entire segment listed in various planning documents Reconstruct I-19 to four lanes in each direction between San Xavier Road and I-10 (I-19 DCR) All interchanges planned for upgrade

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab (Column D). The Step 3 sample template is illustrated in **Table 3** for the I-19 corridor.

The steps to compete Step 3 include:

Step 3.1

Input data from Mobility Index worksheet and corridor observations in appropriate columns for Roadway Variables (Column E through Column L).

Step 3.2

Input traffic variable data in appropriate columns as indicated in Columns M-O, Buffer Index scores will auto populate in Columns P and Q.

Step 3.3

In Column R input relevant mobility related infrastructure located within each segment as appropriate

Step 3.4

In the lower portion of Column E – Column M input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for 2009-2013 on ADOT's 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures (Column E)
- % Closures (No Reason) (Column F)
- % Incidents/Accidents (Column H)
- % Obstructions/Hazards (Column J)
- % Weather Related (Column L)

Step 3.5

In the lower portion of Column N/O, list the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. For example, the border patrol check point in Segment 3 of I-19 is a non-actionable condition.

Step 3.6

Considering all information input, identify and list the contributing factors to the Final Need score (Lower portion of Column P).

Table 3 - Step 3 Example

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Exisitng LOS	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)	SB Buffer Index (PTI-TTI)	
19-1	0-3	3	Low	Interstate	Fringe Urban	Rolling	2	25-65	None	Both	0%	A-C	A-C	7%	0.88	0.29	1/4 mile non-divived in Nogales
19-2	3-18	15	None	Interstate	Rural	Level	2	75	None	Divided	0%	A-C	A-C	8%	0.09	0.09	None
19-3	18-30	12	Low	Interstate	Rural	Level	2	75	None	Divided	0%	A-C	A-C	11%	0.92	0.06	None
19-4	30-40	9	None	Interstate	Fringe Urban	Level	2	65-75	None	Divided	0%	A-C	A-C	13%	0.03	0.06	None
19-5	40-57	18	Low	Interstate	Fringe Urban	Level	2	65-75	None	Divided	0%	A-C	D	14%	0.05	0.07	None
19-6	57-64	7	High	Interstate	Urban	Level	2	55-65	None	Divided	0%	A-C	E/F	7%	0.03	0.10	3 lanes each direction between Ajo (SR 86) TI and I-19/I-10 Interchange

Segment	Segment Mileposts (MP)	Segment Length (miles)	Refinied Need	Closure Extent									Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# of Closures	% Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
19-1	0-3	3	Low	6	0	0%	5	83%	0	0%	1	17%	1/4 mile of Non-freeway urban section	• Urban portion of I-19 within Nogales, beginning as a low-speed non-divided cross-section and transitioning to a higher-speed controlled access 4-lane interstate. • Existing and future traffic LOS is good, but the urban environment and rolling terrain may contribute to accident and weather-related closures. • High deficiencies in northbound TTI and PTI are likely related to lower posted speed limits on the non-divided section.
19-2	3-18	15	None	30	0	0%	29	97%	1	3%	0	0%	None	• Elevated incident/accident-related closures not sufficient to lower the TTI/PTI, but may be associated with periodic congestion at I-19/US 189 TI.
19-3	18-30	12	Low	9	0	0%	7	78%	2	22%	0	0%	Border Checkpoint in NB direction	• Elevated northbound TTI/PTI Need related to Border Patrol checkpoint near Tubac causes temporary delays and slower average speeds for length of segment. Non-actionable condition. • 78% of closures related to incidents/accidents.
19-4	30-40	9	None	12	1	8%	10	83%	1	8%	0	0%	None	• No reported performance deficiencies. • 83% of closures incidents/accidents-related.
19-5	40-57	18	Low	42	0	0%	42	100%	0	0%	0	0%	None	• Elevated number of closures 100% incident/accident-related • Multiple TI and ramp improvement projects planned for near-term expected to help maintain acceptable LOS and reduce accidents.
19-6	57-64	7	High	21	7	33%	14	67%	0	0%	0	0%	None	• High Mobility Index performance Need, based on heavy northbound flows entering Tucson urban area. • Congested levels existing peak hour V/C and future daily V/C. • The number of weekdays vs. weekend days in which traffic volumes exceed acceptable LOS are nearly equal. There is no spike in traffic that can be attributed to work-related (week day) or recreational (weekend) traffic. • 67% of closures incidents/accidents-related, with 33% unidentified. May be related to increased congestion in urban area.

Safety Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Safety Performance Area. The 5-step process is listed below. When Step 3 is completed for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to identify common or overlapping deficiencies for multiple performance areas. Corridor deficiencies are then translated to needs in Step 5 of the process.

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

The Task 4 – Safety Needs Assessment Excel spreadsheet contains 3 tabs, one each for Steps 1 - 3.

The input required to populate the Step 1 template includes transferring the corridor characteristics and existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for safety. As each performance score is input into the template, the Level of Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the corridor characteristics information. This includes segment operating environments (Column B) and segment length (Column C). Also specify on cell D38 if the safety performance area is an emphasis area as determined in Task 3. The "Level of Need" is dependent on the input of the operating environment and "Emphasis Area" as the thresholds dynamically update accordingly.

Input the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score (paste values only) for each segment to the appropriate "Performance Score" column and conditional formatting should color each cell green, yellow, or red based on the corresponding performance thresholds.

Step 1.2

The thresholds for the corridor safety index are based on the segments' operating environments. To ensure that the correct corridor safety index threshold are applied, input the unique segment operating environments that exist with the corridor. Once the input is complete, the average of the Good/Fair and Fair/Poor thresholds for each of the operating environments is calculated and the "Level of Need" thresholds will be derived and applied to the main Step 1 Table.

Step 1.3

Confirm that the following criteria for "Insufficient Data" has been applied and that the resulting Level of Need has been shown as "N/A" where applicable.

- Crash frequency for a segment is less than 5 crashes over the 5-year crash analysis period.
- The change in +/- 1 crash results in the change of need level of 2 levels (i.e., changes from Good to Poor or changes from Poor to Good).
- The average segment crash frequency for the overall corridor (total fatal plus incapacitating injury crash frequency divided by the number of corridor segments) is less than 2 per segment over the 5-year crash analysis period.

Step 1.4

Confirm that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Table 1 - Step 1 Example

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				Performance Score	Performance Objective	Level of Need	NB/EB Directional Safety Index	SB/WB Directional Safety Index	Performance Objective	NB/EB Level of Need	SB/WB Level of Need	Performance Score	Performance Objective	Level of Need
1	4 or 5 Lane Undivided Highway	5	29-34	1.30	Average or Better	Medium	1.29	1.31	Average or Better	Medium	Medium	17%	Average or Better	None
2	2 or 3 Lane Undivided Highway	9	34-43	1.29	Average or Better	High	2.42	0.16	Average or Better	High	None	Insufficient Data	Average or Better	N/A
3	2 or 3 Lane Undivided Highway	17	43-60	0.07	Average or Better	None	0.13	0.00	Average or Better	None	None	Insufficient Data	Average or Better	N/A
4	2 or 3 Lane Undivided Highway	20	60-80	1.48	Average or Better	High	2.00	0.95	Average or Better	High	None	20%	Average or Better	None
5	2 or 3 Lane Undivided Highway	24	80-104	0.74	Average or Better	None	0.00	1.48	Average or Better	None	High	Insufficient Data	Average or Better	N/A
6	4 or 5 Lane Undivided Highway	2.5	104-111	2.23	Average or Better	High	4.46	0.00	Average or Better	High	None	Insufficient Data	Average or Better	N/A
7	2 or 3 Lane Undivided Highway	20	111-131	0.00	Average or Better	None	0.00	0.00	Average or Better	None	None	Insufficient Data	Average or Better	N/A
8	2 or 3 Lane Undivided Highway	11	131-142	0.14	Average or Better	None	0.28	0.00	Average or Better	None	None	75%	Average or Better	High
9	4 or 5 Lane Undivided Highway	6	142-149	1.10	Average or Better	Medium	2.13	0.07	Average or Better	High	None	17%	Average or Better	None
10	2 or 3 Lane Undivided Highway	14	149-162	0.62	Average or Better	None	0.28	0.96	Average or Better	None	None	50%	Average or Better	None
11	2 or 3 Lane Undivided Highway	14	162-176	1.91	Average or Better	High	1.89	1.93	Average or Better	High	High	64%	Average or Better	High
12	4 or 5 Lane Undivided Highway	14	176-190	1.77	Average or Better	High	1.63	1.91	Average or Better	High	High	45%	Average or Better	Low
13	2 or 3 Lane Undivided Highway	12	190-202	1.06	Average or Better	Medium	1.88	0.24	Average or Better	High	None	44%	Average or Better	None
Safety Emphasis Area?		Yes	Weighted Average	0.91	Above Average	Low								

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	% of Fatal + Incapacitating Injury Crashes Involving Trucks			% of Fatal + Incapacitating Injury Crashes Involving Motorcycles			% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
1	4 or 5 Lane Undivided Highway	5	29-34	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
2	2 or 3 Lane Undivided Highway	9	34-43	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
3	2 or 3 Lane Undivided Highway	17	43-60	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
4	2 or 3 Lane Undivided Highway	20	60-80	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
5	2 or 3 Lane Undivided Highway	24	80-104	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
6	4 or 5 Lane Undivided Highway	2.5	104-111	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
7	2 or 3 Lane Undivided Highway	20	111-131	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
8	2 or 3 Lane Undivided Highway	11	131-142	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
9	4 or 5 Lane Undivided Highway	6	142-149	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
10	2 or 3 Lane Undivided Highway	14	149-162	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
11	2 or 3 Lane Undivided Highway	14	162-176	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
12	4 or 5 Lane Undivided Highway	14	176-190	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
13	2 or 3 Lane Undivided Highway	12	190-202	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium

Step 2: Final Needs

The Initial Need will be carried over to Step 2 (Column D). The Step 2 sample template is illustrated in **Table 2** for the I-40 corridor. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to Column D of the Step 2 template.

Step 2.2

Using the crash concentration (hot spot) map developed as part of the baseline corridor performance, note the direction of travel and approximate milepost limits of each hot spot.

Step 2.3

Identify recently completed or under construction projects (Column F) that would be considered relevant to safety performance. Include only projects that were not taken into account during the crash data analysis period (2009 – 2013). Any completed or under construction roadway project after 2013 that has the potential to mitigate a safety issue on a corridor segment should be listed in the template. Sources of recent or current project activity can include ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need (Column G) based on the following criteria:

- If there is a crash hot spot concentration on a “None” segment, upgrade the need rating to “Low”.

Step 2.5

Note any programmed projects that could have the potential to mitigate any safety need on the segment in Column H. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT’s 5-year construction program. Any other relevant issues identified in previous reports should also be reported in Column H.

Table 2 - Step 2 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Hot Spots	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address need or other relevant issues identified in previous reports)
1	11	0-11	High			High	No programmed project with potential to address need
2	32	11-43	Medium			Medium	*Programmed:* bridge deck rehabilitations at Boulder Wash EB, Chemehuevi Wash EB, Francona TI UP, Francona Wash EB, and Illavar Wash EB in FY 2016 at MP 11-18 and Haviland Rest Area improvements in FY 2018 at MP 23
3	12	43-55	Medium	EB/WB crash concentration in Kingman area (MP 48 - 51)	Repaving done in 2015 WB at MP 43	Medium	Not clear if repaving done in 2015 addressed need Programmed: bridge deck rehabilitations at Holy Moses Wash EB/WB in FY 2017 at MP 46
4	19	55-74	High		Repaving done in 2014 EB/WB at MP 57-71.5. Repaving underway in 2015-2016 EB/WB at MP 72-74	High	Not clear if repaving done in 2014 and underway in 2015-2016 addressed need Programmed: Blake Ranch Road TI improvements in FY 2017 at MP 66 and Peacock Wash bridge rehabilitation in FY 2018 at MP 73
5	6	74-80	None		Repaving underway in 2015-2016 EB/WB at MP 74-79	None	No identified need
6	18	80-98	High		Repaving underway in 2015-2016 EB/WB at MP 86-98 includes guard rail and rumble strip installation and bridge repairs Bridge rehabilitation done in 2015 for Willow Creek Bridge #2 at MP 82-83	High	Not clear if repaving underway in 2015-2016 and bridge rehabilitation done in 2015 addressed need Programmed: pavement preservation in FY 2019 at MP 80-87, bridge deck rehabilitations at Willow Creek Br #1 EB, #3 EB, #4 EB, #5 EB in FY 2016 at MP 83-86, and rockfall mitigation in FY 2017 at MP 83
7	10	98-108	Medium		Repaving underway in 2015-2016 EB/WB at MP 98-108 includes guard rail and rumble strip installation and bridge repairs	Medium	Repaving underway in 2015-2016 could at least partially address need but uncertain at this point
8	12	108-120	None			None	*Programmed:* pavement preservation in FY 2019 at MP 108-120
9	23	120-143	None			None	*Programmed:* sign rehabilitation in FY 2017 at MP 125-143
10	17	143-160	High	WB crash concentration near Pine Springs (MP 157 - 158)	Rehabilitation of ten bridge decks near the West Ash Fork Traffic Interchange in 2015 at MP 144-147	High	Rehabilitation of bridge decks in 2015 could at least partially address need but uncertain at this point Programmed: sign rehabilitation in FY 2017 at MP 143-160
11	8	160-168	Medium			Medium	*Programmed:* sign rehabilitation in FY 2017 at MP 160-168, pavement preservation in FY 2019 at MP 161-165, pavement replacement in FY 2018 at MP 162-168, and bridge deck rehabilitation at E Williams RR OP EB/WB in FY 2019 at MP 165
12	16	168-184	None			None	No identified need
13	6	184-190	None			None	No identified need
14	6	190-196	None			None	No identified need

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab (Row 22). The Step 3 sample template is illustrated in **Table 3** for the I-40 corridor.

A separate *Crash Summary Sheet* file contains summaries for 8 crash attributes for the entire corridor, for each corridor segment, and for statewide roadways with similar operating environments (the database of crashes on roadways with similar operating environments was developed in Task 2 (the baseline corridor performance)). The crash attribute summaries are consistent with the annual ADOT Publication, *Crash Facts*. The 8 crash attribute summaries consist of the following

- First Harmful Event (FHET)
- Crash Type (CT)
- Violation or Behavior (VB)
- Lighting Condition (LC)
- Roadway Surface Type (RST)
- First Unit Event (FUE)
- Driver Physical Condition (Impairment)
- Safety Device Usage (Safety Device

Non-colored tabs in this spreadsheet auto-populate with filtered crash attributes. Each tab is described below

- **Step_3_Summary** – This tab contains the filtered summary of crashes that exceed statewide thresholds for crashes on roadways with similar operating environments. Data in this tab are copied into the Step 3 template.
- **Statewide** – This tab contains a summary of statewide crashes from roadways with similar operating environments filtered by the 8 crash type summaries listed above. The crash type summaries calculate statewide crash thresholds (% total for fatal plus incapacitating crashes). The crash thresholds were developed to provide a statewide expected proportion of crash attributes against which the corridor segments' crash attributes can be compared. The crash thresholds were developed using the *Probability of Specific Crash Types Exceeding a Threshold Proportion* as shown in the Highway Safety Manual, Volume 1 (2010). The thresholds are automatically calculated within the spreadsheet. The threshold proportion was calculated as follows

$$p*_i = \frac{\sum N_{Observed,i}}{\sum N_{Observed,i(total)}}$$

Where:

$p*_i$ = Threshold proportion

$\sum N_{Observed,i}$ = Sum of observed target crash frequency within the population

$\sum N_{Observed,i(total)}$ = Sum of total observed crash frequency within the population

A minimum crash sample size of 5 crashes over the 5-year crash analysis period is required for a threshold exceedance to be displayed in the Step 3 template. The probability of exceeding the crash threshold was not calculated to simplify the process.

- **Corridor** – A summary of corridor-wide crashes filtered by the 8 crash attribute summaries listed above.
- **Segment FHET** – A segment-by-segment summary of crashes filtered by first harmful event attributes.
- **Segment CT** – A segment-by-segment summary of crashes filtered by crash type attributes.
- **Segment VB** - A segment-by-segment summary of crashes filtered by violation or behavior attributes.
- **Segment LC** – A segment-by-segment summary of crashes filtered by lighting condition attributes.
- **Segment RST** – A segment-by-segment summary of crashes filtered by roadway surface attributes.
- **Segment FUE** – A segment-by-segment summary of crashes filtered by first unit event attributes.
- **Segment Impairment** – A segment-by-segment summary of crashes filtered by driver physical condition attributes related to impairment.
- **Segment Safety Device** – A segment-by-segment summary of crashes filtered by safety device usage attributes

The data from the "STATE_DATA" tab for crashes in the corridor, including the 8 crash attribute categories, must be inserted into the appropriate column (highlighted in gray) of the "INPUT_CORRIDOR_DATA" tab in order for the 8 crash attribute tabs to be populated correctly. The "Calcs" tab includes formulas that draw on the information provided in the other tabs to generate the table in the Step_3_Summary tab.

The steps to compete Step 3 include:

Step 3.1

Using the Crash_Summary_Sheet.xlsx, go to the "Step_3_Summary" tab. Input the operating environments for each segment in the table (O3:Q27).

Step 3.2

Filter data from the ADOT database for the "CORRIDOR_DATA" tab by inserting the following data in the appropriate columns that are highlighted in gray for the "INPUT_CORRIDOR_DATA" tab:

- Incident ID: Column A
- Incident Crossing Feature (MP): Column B
- Segment Number (Non-native ADOT data – must be manually assigned based on the location of the crash): Column C
- Operating Environment (Non-native ADOT data – should already be assigned but if for some reason it isn't, it will need to be manually assigned): Column D
- Incident Injury Severity: Column E
- Incident First Harmful Description: Column F
- Incident Collision Manner: Column H
- Incident Lighting Condition Description: Column I

- Unit Body Style: Column J
- Surface Condition: Column K
- First Unit Event Sequence: Column L
- Person Safety Equipment: Column N
- Personal Violation or Behavior: Column O
- Impairment: Column P

Note that columns highlighted in yellow (G, M, Q) perform a calculated input to aggregate specific crash descriptions. For example, crashes can contain various attributes for animal-involved crashes. The crash attributes that involve an animal were combined into a common attribute, such as "ANIMAL". This will allow the summaries to be consistent with the ADOT *Crash Facts*.

The data in the Impairment category contains blank descriptions if it was found that there was "No Apparent Influence" or if it was "Unknown". Using the crash data fields "PersonPhysicalDescription" 0 - 99, fill in the blank columns to reflect if the physical description is described as "No Apparent Influence" or "Unknown". Note that the native physical description data from the ADOT database may need to be combined to a single column.

Step 3.3

Confirm that the crash database is being properly filtered by comparing crash frequencies from the summary tables with the frequencies developed in Task 2. For example, the lookup function will fail if the filter is for "NO IMPROPER ACTION" if the database has the attribute of "NO_IMPROPER_ACTION".

Step 3.4

Copy and paste the Step_3_Summary into the Task 4 – Safety Needs Assessment spreadsheet in the Step 3 tab. Paste values only and remove the summaries with "0%s" for a clean display. Where duplicate values exist, go to the "Calcs" tab in the Crash_Summary_Sheet file to determine which categories have the same %. If there are more crash types with the same % than there is space in the table, select the crash type with the highest difference between the segment % and the statewide average %

Step 3.5

The Step 3 table in the Task 4 – Safety Needs Assessment spreadsheet should be similar to the Step 3 template. In the Segment Crash Summaries row, the top three crash attributes are displayed. Change the font color of the crash attributes that exceed the statewide crash threshold to red for emphasis. The attributes with a red font in the "Calcs" tab have exceeded statewide crash thresholds. Note that corridor-wide values are not compared to statewide values as corridor-wide values are typically a blend of multiple similar operating environments while the statewide values apply to one specific similar operating environment.

Step 3.6

Provide a summary of any observable patterns found within the crash Hot Spots, if any exist in the segments.

Step 3.7

Input any historic projects (going no further back than 2000) that can be related to improving safety. Projects more than five years old may have exceeded their respective design life and could be contributing factors to safety performance needs.

Step 3.8

Input key points from District interviews or any important information from past discussions with District staff that is consistent with needs and crash patterns identified as part of the performance and needs assessment as this may be useful in identifying contributing causes. This information may be obtained from District Maintenance personnel by requesting the mile post locations that may be considered safety issues.

Step 3.9

For segments with one or more of the following characteristics, review crashes of all severity levels (not just fatal and incapacitating injury crashes). Identify likely contributing factors and compare that to the above statewide average comparison findings already calculated for fatal and incapacitating injury crashes. Refine the contributing factors list accordingly.

- Segments with Medium or High need
- Segments with a crash hot spot concentration (but only review crashes at the concentration areas)
- Segments with no apparent predominant contributing factors based on the comparison of fatal and incapacitating crashes to statewide averages if the segment has a Medium or High need.

Step 3.10

Considering all information in Steps 1-3, list the contributing factors using engineering judgment and the information on contributing factors available in Section 6.2 of the 2010 Highway Safety Manual. Additional sources for determining contributing factors may include aerial, "streetview", and/or ADOT photologs. Other documents such as Design Concept Reports (DCR) or Road Safety Assessments can provide insight into the study corridor's contributing factors.

Add comments as needed on additional information related to contributing factors that may have been provided by input from ADOT staff.

Table 3 - Step 3 Example

Segment Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Corridor-Wide Crash Characteristics**
Segment Length (miles)	**11**	**32**	**12**	**19**	**6**	**18**	**10**	**12**	**23**	**17**	**8**	**16**	**6**	**6**	
Segment Milepost (MP)	**0-11**	**11-43**	**43-55**	**55-74**	**74-80**	**80-98**	**98-108**	**108-120**	**120-143**	**143-160**	**160-168**	**168-184**	**184-190**	**190-196**	
Final Need	High	Medium	Medium	High	None	High	Medium	None	None	High	Medium	None	None	None	
Segment Crash Overview	**4** Crashes were fatal **6** Crashes had incapacitating injuries **1** Crash involved trucks	**8** Crashes were fatal **29** Crashes had incapacitating injuries **9** Crashes involved trucks	**7** Crashes were fatal **12** Crashes had incapacitating injuries **2** Crashes involved trucks	**10** Crashes were fatal **15** Crashes had incapacitating injuries **6** Crashes involved trucks	**1** Crash was fatal **3** Crashes had incapacitating injuries **1** Crash involved trucks	**7** Crashes were fatal **15** Crashes had incapacitating injuries **4** Crashes involved trucks	**3** Crashes were fatal **7** Crashes had incapacitating injuries **1** Crash involved trucks	**0** Crashes were fatal **13** Crashes had incapacitating injuries **2** Crashes involved trucks	**3** Crashes were fatal **23** Crashes had incapacitating injuries **3** Crashes involved trucks	**10** Crashes were fatal **15** Crashes had incapacitating injuries **5** Crashes involved trucks	**2** Crashes were fatal **6** Crashes had incapacitating injuries **1** Crash involved trucks	**1** Crash was fatal **11** Crashes had incapacitating injuries **0** Crashes involved trucks	**1** Crash was fatal **3** Crashes had incapacitating injuries **1** Crash involved trucks	**1** Crash was fatal **3** Crashes had incapacitating injuries **1** Crash involved trucks	**58** Crashes were fatal **161** Crashes had incapacitating injuries **37** Crashes involved trucks
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **First Harmful Event Type**	**40%** **Involve Collision with Motor Vehicle** **40%** Involve Overturning **10%** **Involve Collision with Pedestrian**	**51%** **Involve Overturning** **27%** **Involve Collision with Fixed Object** **16%** Involve Collision with Motor Vehicle	**47%** **Involve Overturning** **37%** **Involve Collision with Motor Vehicle** **11%** Involve Collision with Fixed Object	**40%** Involve Overturning **24%** **Involve Collision with Motor Vehicle** **12%** Involve Collision with Fixed Object	N/A - Sample size too small	**50%** **Involve Overturning** **14%** **Involve Other Non-Collision** **14%** Involve Collision with Fixed Object	**70%** **Involve Overturning** **10%** **Involve Collision with Pedestrian** **10%** **Involve Other Non-Collision**	**54%** **Involve Overturning** **15%** Involve Other Non-Collision **15%** Involve Collision with Fixed Object	**42%** Involve Overturning **23%** **Involve Collision with Motor Vehicle** **19%** **Involve Other Non-Collision** **8%** Involve Collision with Fixed Object	**48%** Involve Overturning **24%** **Involve Other Non-Collision** **8%** Involve Collision with Fixed Object	**63%** **Involve Overturning** **25%** **Involve Collision with Fixed Object** **12%** **Involve Collision with Non-Fixed Object** **17%** Involve Collision with Motor Vehicle	**50%** **Involve Overturning** **17%** **Involve Collision with Fixed Object**	N/A - Sample size too small	N/A - Sample size too small	**50%** Involve Overturning **17%** Involve Collision with Motor Vehicle **14%** Involve Collision with Fixed Object
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Collision Type**	**40%** Involve Single Vehicle **20%** **Involve Other** **10%** **Involve Angle**	**81%** **Involve Single Vehicle** **11%** Involve Rear End **3%** **Involve Head On**	**58%** Involve Single Vehicle **16%** **Involve Rear End** **11%** **Involve Head On**	**56%** Involve Single Vehicle **28%** **Involve Rear End** **12%** **Involve Other**	N/A - Sample size too small	**77%** **Involve Single Vehicle** **9%** **Involve Sideswipe (same)** **9%** Involve Rear End	**90%** **Involve Single Vehicle** **10%** Involve Other	**85%** **Involve Single Vehicle** **8%** **Involve Angle** **8%** **Involve Head On**	**69%** Involve Single Vehicle **19%** **Involve Rear End** **4%** **Involve Angle**	**84%** **Involve Single Vehicle** **8%** Involve Rear End **4%** **Involve Unknown**	**88%** **Involve Single Vehicle** **12%** **Involve Other**	**83%** **Involve Single Vehicle** **8%** **Involve Left Turn** **8%** **Involve Other**	N/A - Sample size too small	N/A - Sample size too small	**74%** Involve Single Vehicle **11%** Involve Rear End **7%** Involve Other
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Violation or Behavior**	**30%** Involve Speed too Fast for Conditions **20%** **Involve Inattention/Distraction** **20%** **Involve No Improper Action**	**27%** **Involve Inattention/Distraction** **27%** Involve Speed too Fast for Conditions **14%** **Unknown**	**47%** **Involve Speed too Fast for Conditions** **11%** Involve Other **11%** Involve Unknown	**52%** **Involve Speed too Fast for Conditions** **20%** **Involve Unknown** **12%** Involve No Improper Action	N/A - Sample size too small	**59%** **Involve Speed too Fast for Conditions** **18%** **Involve Inattention/Distraction** **14%** Involve No Improper Action	**40%** **Involve Speed too Fast for Conditions** **10%** **Involve Faulty/Missing** **10%** **Involve Exceeded Lawful Speed**	**38%** **Involve Speed too Fast for Conditions** **31%** **Involve No Improper Action** **8%** **Involve Failure to Keep in Proper Lane**	**46%** **Involve Speed too Fast for Conditions** **23%** **Involve No Improper Action** **12%** **Involve Other**	**48%** **Involve Speed too Fast for Conditions** **16%** Involve No Improper Action **12%** **Involve Other**	**63%** **Involve Speed too Fast for Conditions** **13%** **Involve Exceeded Lawful Speed** **13%** Involve Inattention/Distraction	**42%** **Involve Speed too Fast for Conditions** **33%** **Involve No Improper Action** **8%** **Involve Failure to Keep in Proper Lane**	N/A - Sample size too small	N/A - Sample size too small	**45%** Involve Speed too Fast for Conditions **17%** Involve No Improper Action **12%** Involve Inattention/Distraction
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Lighting Conditions**	**70%** **Occur in Daylight Conditions** **20%** Occur in Dark-Unlighted Conditions **10%** **Occur in Dawn Conditions**	**59%** Occur in Daylight Conditions **24%** Occur in Dark-Unlighted Conditions **11%** **Occur in Dawn Conditions**	**63%** **Occur in Daylight Conditions** **26%** Occur in Dark-Unlighted Conditions **11%** **Occur in Dark-Lighted Conditions**	**68%** **Occur in Daylight Conditions** **28%** Occur in Dark-Unlighted Conditions **4%** **Occur in Dark-Lighted Conditions**	N/A - Sample size too small	**50%** **Occur in Dark-Unlighted Conditions** **50%** Occur in Daylight Conditions	**50%** **Occur in Dark-Unlighted Conditions** **40%** Occur in Daylight Conditions **10%** **Occur in Dawn Conditions**	**85%** **Occur in Daylight Conditions** **15%** Occur in Dark-Unlighted Conditions	**58%** Occur in Daylight Conditions **31%** Occur in Dark-Unlighted Conditions **8%** **Occur in Dusk Conditions**	**72%** **Occur in Daylight Conditions** **28%** Occur in Dark-Unlighted Conditions	**50%** Occur in Daylight Conditions **25%** **Occur in Dawn Conditions** **25%** Occur in Dark-Unlighted Conditions	**50%** **Occur in Dark-Unlighted Conditions** **50%** Occur in Daylight Conditions	N/A - Sample size too small	N/A - Sample size too small	**63%** Occur in Daylight Conditions **30%** Occur in Dark-Unlighted Conditions **4%** Occur in Dawn Conditions
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Surface Conditions**	**100%** **Involve Dry Conditions**	**97%** **Involve Dry Conditions** **3%** Involve Ice/Frost Conditions	**100%** **Involve Dry Conditions**	**88%** **Involve Dry Conditions** **8%** **Involve Wet Conditions** **4%** **Involve Slush Conditions**	N/A - Sample size too small	**73%** Involve Dry Conditions **14%** **Involve Wet Conditions** **9%** **Involve Ice/Frost Conditions**	**80%** Involve Dry **20%** **Involve Ice/Frost Conditions**	**100%** **Involve Dry Conditions**	**81%** Involve Dry Conditions **8%** **Involve Slush Conditions** **8%** **Involve Ice/Frost Conditions**	**56%** Involve Dry Conditions **24%** **Involve Wet Conditions** **8%** **Involve Water (standing or moving) Conditions**	**38%** **Involve Ice/Frost** **38%** Involve Dry Conditions **13%** **Involve Slush Conditions**	**42%** Involve Dry Conditions **25%** **Involve Snow Conditions** **17%** **Involve Slush Conditions**	N/A - Sample size too small	N/A - Sample size too small	**80%** Involve Dry Conditions **6%** Involve Wet Conditions **6%** Involve Ice/Frost Conditions
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **First Unit Event**	**50%** **Involve a first unit event of Motor Vehicle in Transport** **20%** **Involve a first unit event of Ran Off the Road (Right)** **10%** **Involve a first unit event of Other Non-Fixed Object**	**38%** **Involve a first unit event of Ran Off the Road (Left)** **19%** Involve a first unit event of Motor Vehicle in Transport **16%** Involve a first unit event of Ran Off the Road (Right)	**32%** Involve a first unit event of Motor Vehicle in Transport **26%** Involve a first unit event of Ran Off the Road (Left) **16%** **Involve a first unit event of Equipment Failure**	**36%** **Involve a first unit event of Motor Vehicle in Transport** **32%** Involve a first unit event of Ran Off the Road (Left) **12%** **Involve a first unit event of Overturn**	N/A - Sample size too small	**36%** **Involve a first unit event of Ran Off the Road (Left)** **18%** Involve a first unit event of Ran Off the Road (Right) **14%** Involve a first unit event of Motor Vehicle in Transport	**60%** **Involve a first unit event of Ran Off the Road (Left)** **20%** **Involve a first unit event of Equipment Failure** **10%** Involve a first unit event of Ran Off the Road (Right)	**46%** **Involve a first unit event of Ran Off the Road (Left)** **15%** **Involve a first unit event of Equipment Failure** **15%** Involve a first unit event of Ran Off the Road (Right)	**38%** **Involve a first unit event of Ran Off the Road (Left)** **23%** **Involve a first unit event of Motor Vehicle in Transport** **12%** **Involve a first unit event of Equipment Failure**	**56%** **Involve a first unit event of Ran Off the Road (Left)** **24%** **Involve a first unit event of Ran Off the Road (Right)** **12%** Involve a first unit event of Motor Vehicle in Transport	**50%** **Involve a first unit event of Ran Off the Road (Left)** **25%** **Involve a first unit event of Collision with Fixed Object** **13%** **Involve a first unit event of Other Non-Collision**	**33%** Involve a first unit event of Ran Off the Road (Left) **17%** **Involve a first unit event of Equipment Failure** **17%** Involve a first unit event of Ran Off the Road (Right)	N/A - Sample size too small	N/A - Sample size too small	**39%** Involve a first unit event of Ran Off the Road (Left) **19%** Involve a first unit event of Motor Vehicle in Transport **15%** Involve a first unit event of Ran Off the Road (Right)
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Driver Physical Condition**	**60%** **No Apparent Influence** **20%** **Fatigued/Fell Asleep** **10%** Under the Influence of Drugs or Alcohol	**46%** No Apparent Influence **27%** **Fatigued/Fell Asleep** **14%** **Under the Influence of Drugs or Alcohol**	**68%** **No Apparent Influence** **21%** **Under the Influence of Drugs or Alcohol** **5%** **Fatigued/Fell Asleep**	**48%** No Apparent Influence **32%** **Unknown** **16%** **Under the Influence of Drugs or Alcohol**	N/A - Sample size too small	**68%** **No Apparent Influence** **18%** **Unknown** **9%** Under the Influence of Drugs or Alcohol	**70%** **No Apparent Influence** **30%** **Unknown**	**77%** **No Apparent Influence** **23%** **Fatigued/Fell Asleep**	**58%** No Apparent Influence **23%** **Fatigued/Fell Asleep** **15%** **Unknown**	**68%** **No Apparent Influence** **16%** **Unknown** **12%** Under the Influence of Drugs or Alcohol	**63%** **No Apparent Influence** **25%** **Fatigued/Fell Asleep** **13%** Under the Influence of Drugs or Alcohol	**83%** **No Apparent Influence** **17%** **Fatigued/Fell Asleep**	N/A - Sample size too small	N/A - Sample size too small	**62%** No Apparent Influence **15%** **Unknown** **13%** Fatigued/Fell Asleep
Segment Crash Summaries (Fatal and Serious Injury Crashes) – **Safety Device Usage**	**50%** **None Used** **20%** Shoulder And Lap Belt Used **10%** **Air Bag Deployed**	**62%** **Shoulder And Lap Belt Used** **16%** None Used **8%** **Unknown**	**53%** **Shoulder And Lap Belt Used** **21%** **None Used** **11%** **Helmet Used**	**40%** Shoulder And Lap Belt Used **20%** None Used **12%** **Unknown**	N/A - Sample size too small	**55%** Shoulder And Lap Belt Used **23%** **None Used** **14%** **Air Bag Deployed/Shoulder-Lap Belt**	**80%** **Shoulder And Lap Belt Used** **10%** **Air Bag Deployed/Shoulder-Lap Belt** **10%** **Not Applicable**	**46%** Shoulder And Lap Belt Used **15%** **Helmet Used** **15%** **Air Bag Deployed/Shoulder-Lap Belt**	**77%** **Shoulder And Lap Belt Used** **12%** None Used **8%** **Air Bag Deployed/Shoulder-Lap Belt**	**72%** **Shoulder And Lap Belt Used** **16%** None Used **8%** **Not Applicable**	**75%** **Shoulder And Lap Belt Used** **25%** **None Used**	**100%** **Shoulder And Lap Belt Used**	N/A - Sample size too small	N/A - Sample size too small	**61%** Shoulder And Lap Belt Used **17%** None Used **7%** Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries	No identified Hot Spot.	No identified Hot Spot.	Hot Spot from MP 48 - 51 EB/WB: 4 Fatal and 8 Incapacitating Injury crashes. 58% involve single vehicles overturning in dry conditions. 50% are a result of running off the road left or right.	No identified Hot Spot.	N/A - Sample size too small	No identified Hot Spot.	No identified Hot Spot.	No identified Hot Spot.	No identified Hot Spot.	Hot Spot from MP 157 - 158 WB: 1 Fatal and 3 Incapacitating Injury crashes. 100% of crashes involve single vehicles running off the road left.	No identified Hot Spot.	No identified Hot Spot.	N/A - Sample size too small	N/A - Sample size too small	
Previously Completed Safety-Related Projects	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	2002, Rumble Strip Construction	
District Interviews/Discussions	• Pavement heaving and deterioration may contribute to safety need. • Severe erosion to drainage berm. If erosion continues water is anticpated to overtop on the interstate (MP 9.3).	• Significant truck crash problem, segment is flat and straight with many run-off-road crashes likely due to inattentive or sleepy drivers. • Distressed pavement in the WB direction causing potholes in the pavement due to the age of the pavement. Currently no future pavement projects are programmed.	• Significant truck crash issues (MP 46 - 53). • Multiple bridge approaches have pavement failure and distortion due to sub-grade failure (MP 44 - 52).			• Large potholes due to the age of the pavement and subgrade.		• Severe roadway fatigue with large potholes with many public complaints filed (MP 112 - 121).	• Significant crack in pavement from initial sub-grade failure. Potential crash hazard (MP 121 - 124).	• Large potholes exist on roadway (MP 155 - 161). Primarily due to deteriorated pavement. • Large potholes exist in the EB direction due to the concrete base failure (MP 152 - 161).				
Contributing Factors	• Roadway departure • Driver inattention/distraction • Pavement surface condition • Shoulder/rumble strip condition • Lack of restraint usage • Improper lane changes Comment: Berm deterioration may create future safety need	• Roadway departure • Driver inattention/distraction • Pavement surface condition • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Driving under the influence Comment: District input supports crash pattern	• Speed too fast for conditions • Improper lane changes • Pavement surface condition • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Urban operating conditions • Driving under the influence • Lack of restraint usage Comment: Programmed bridge deck replacement at MP 46 may help address EB safety need	• Speed too fast for conditions • Improper lane changes • High traffic volume operating conditions • Driving under the influence • Slippery/wet pavement surface Comment: Ongoing pavement preservation project may help address EB/WB safety need	N/A - Sample size too small	• Speed too fast for conditions • Driver inattention/distraction • Roadway departure • Pavement surface condition • Traffic control device reflectivity • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Lack of restraint usage • Slippery/wet pavement surface Comment: Ongoing pavement preservation, shoulder improvements, and bridge rehabilitation may help address safety need Comment: Programmed pavement preservation, bridge deck replacement, and rockfall mitigation projects may help address safety need	• Roadway departure • Traffic control device reflectivity • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Slippery/wet pavement surface Comment: Ongoing pavement preservation, shoulder improvements, and bridge rehabilitation may help address safety need	• Speed too fast for conditions • Driver inattention/distraction • Roadway departure • Pavement surface condition • Shoulder/rumble strip condition • Clear zone slopes and obstructions Comment: Programmed pavement preservation project may help address safety need	• Speed too fast for conditions • Driver inattention/distraction • Improper lane changes • High traffic volume operating conditions • Roadway departure • Pavement surface condition • Slippery/wet pavement surface Comment: Programmed sign rehabilitation may help address safety need	• Speed too fast for conditions • Roadway departure • Pavement surface condition • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Slippery/wet pavement surface Comment: Ongoing bridge deck replacement may help address safety need Comment: Programmed sign rehabilitation may help address safety need	• Speed too fast for conditions • Driver inattention/distraction • Roadway departure • Pavement surface condition • Shoulder/rumble strip condition • Lack of restraint usage • Slippery/wet pavement surface Comment: Programmed sign rehabilitation, pavement preservation and replacement, and bridge deck replacement may help address safety need	• Speed too fast for conditions • Driver inattention/distraction • Roadway departure • Pavement surface condition • Traffic control device reflectivity • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Slippery/wet pavement surface	N/A - Sample size too small	N/A - Sample size too small	• Speed too fast for conditions • Driver inattention/distraction • Improper lane changes • Roadway departure • Pavement surface condition • Shoulder/rumble strip condition • Clear zone slopes and obstructions • Slippery/wet pavement surface

Freight Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a five-step needs assessment process for the Freight Performance Area. The five-step process is listed below. When Step 3 is completed for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to identify common or overlapping needs for multiple performance areas. Corridor needs are then identified in Step 5 of the process.

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

The Task 4 - Freight Needs Assessment Excel spreadsheet contains 3 tabs for Steps 1 - 3.

Step 1: Initial Needs

The Step 1 sample template is illustrated in **Table 1** for the I-40 corridor:

The input required to populate the Step 1 template includes transferring the existing performance score and color for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Freight. As each performance score is input into the template, the Initial Need (Column Z) will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted score, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score for each segment to the appropriate "Performance Score" column. Select the *Facility Operations* for each segment from the drop-down list (Column B) and input whether or not the performance area is an emphasis area (B41). The corridor needs assessment scales will be updated automatically.

Step 1.2

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Table 1 - Step 1 Example

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTI (trucks only)					Directional PTI (trucks only)					Closure Duration (hours/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							NB/EB	SB/WB		NB/EB	SB/WB	NB/EB	SB/WB		NB/EB	SB/WB	NB/EB	SB/WB		NB/EB	SB/WB				
1	Interrupted	29-34	5	0.28	Fair or Better	Medium	1.15	1.19	Fair or Better	None	None	3.70	3.32	Fair or Better	None	None	117.61	14.88	Fair or Better	Medium	None	No UP	Fair or Better	None	Medium
2	Uninterrupted	34-43	9	0.62	Fair or Better	High	1.08	1.00	Fair or Better	None	None	2.03	1.17	Fair or Better	High	None	27.89	3.62	Fair or Better	None	None	No UP	Fair or Better	None	High
3	Uninterrupted	43-60	17	0.79	Fair or Better	None	1.03	1.03	Fair or Better	None	None	1.25	1.28	Fair or Better	None	None	28.05	0.00	Fair or Better	None	None	No UP	Fair or Better	None	None
4	Uninterrupted	60-80	20	0.13	Fair or Better	High	1.28	1.11	Fair or Better	Medium	None	13.66	1.52	Fair or Better	High	Medium	10.18	2.19	Fair or Better	None	None	No UP	Fair or Better	None	High
5	Uninterrupted	80-104	24	0.72	Fair or Better	Low	1.04	1.11	Fair or Better	None	None	1.13	1.65	Fair or Better	None	High	2.68	7.13	Fair or Better	None	None	No UP	Fair or Better	None	Low
6	Interrupted	104-111	2.5	0.29	Fair or Better	Medium	1.62	1.44	Fair or Better	Low	None	3.23	3.62	Fair or Better	None	None	0.00	46.96	Fair or Better	None	None	No UP	Fair or Better	None	Medium
7	Uninterrupted	111-131	20	0.68	Fair or Better	Medium	1.10	1.09	Fair or Better	None	None	1.46	1.50	Fair or Better	Medium	Medium	133.60	7.49	Fair or Better	Medium	None	No UP	Fair or Better	None	High
8	Uninterrupted	131-142	11	0.55	Fair or Better	High	1.04	1.02	Fair or Better	None	None	2.22	1.44	Fair or Better	High	Medium	10.13	166.29	Fair or Better	None	High	No UP	Fair or Better	None	High
9	Interrupted	142-149	6	0.18	Fair or Better	Medium	1.41	1.33	Fair or Better	None	None	7.04	4.27	Fair or Better	High	Low	106.46	22.77	Fair or Better	Medium	None	27.83	Fair or Better	None	High
10	Uninterrupted	149-162	14	0.79	Fair or Better	None	1.10	1.00	Fair or Better	None	None	1.41	1.13	Fair or Better	Low	None	39.55	33.24	Fair or Better	None	None	No UP	Fair or Better	None	Low
11	Uninterrupted	162-176	14	0.64	Fair or Better	Medium	1.18	1.10	Fair or Better	None	None	1.56	1.55	Fair or Better	Medium	Medium	27.94	53.85	Fair or Better	None	None	No UP	Fair or Better	None	Medium
12	Interrupted	176-190	14	0.22	Fair or Better	Medium	1.32	1.28	Fair or Better	None	None	5.29	3.96	Fair or Better	Medium	None	67.30	11.80	Fair or Better	None	None	16.41	Fair or Better	None	Medium
13	Uninterrupted	190-202	12	0.19	Fair or Better	High	1.31	2.74	Fair or Better	Medium	High	3.09	7.66	Fair or Better	High	High	18.23	20.92	Fair or Better	None	None	No UP	Fair or Better	None	High
Emphasis Area?	Yes	Weighted Average		0.52	Good	High																			

Measure	None >=	> Low <		> Medium <		High <=
Corridor Freight Index (Emphasis Area)	0.77	0.77	0.68	0.68	0.60	0.60
Corridor Freight Index (Non-Emphasis Area)	0.68	0.68	0.64	0.64	0.56	0.56
Freight Index (Segment)						
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Interrupted	0.42	0.42	0.33	0.33	0.17	0.17
Uninterrupted	0.74	0.74	0.70	0.70	0.64	0.64
Measure	**None <=**	**< Low >**		**< Medium >**		**High >=**
Directional TTI						
Interrupted	1.53	1.53	1.77	1.77	2.23	2.23
Uninterrupted	1.21	1.21	1.27	1.27	1.39	1.39
Directional PTI						
Interrupted	4.00	4.00	5.00	5.00	7.00	7.00
Uninterrupted	1.37	1.367	1.43	1.43	1.57	1.57
Closure Duration						
All Facility Operations	71.09	71.09	97.97	97.97	151.75	151.75
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Bridge Clearance (feet)						
All Bridges	16.25	16.25	16.00	16.00	15.50	15.50

Step 2: Final Needs

The Initial Need will be carried over to Step 2 (Column D). The Step 2 sample template is illustrated in **Table 2** for the I-40 corridor.

The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial need from the Step 1 template to Column D of the Step 2 template.

Step 2.2

Note in Column E any truck height restriction hot spots (clearance < 16') identified as part of the baseline corridor performance. For each entry, note the milepost of the height restriction and if the height restriction can be detoured by ramping around the obstruction. If it is not possible for a truck to ramp around the height restriction, note the existing height as well.

Step 2.3

Identify recently completed or under construction projects (Column F) that would be considered relevant to freight performance. Include only projects that were not taken into account during the freight data analysis period. Any completed or under construction roadway project after the date of the data that has the potential to mitigate a freight issue on a corridor segment should be listed in the template. Such projects can include the construction of climbing lanes or Dynamic Message Signs (DMS) installation. Sources of recent or current project activity can be ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need (Column G) using the following criteria:

- If there is one or more truck height restriction hot spots (Column E) where a truck cannot ramp around on a 'None' segment, increase (i.e., worsen) the need rating to 'Low'.
- If a recent project (Column F) has superseded the performance rating data and it is certain the project addressed the need, change the need rating to "None".
- If a recent project (Column F) has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current need rating and note the uncertainty as a comment in Column H.

Step 2.5

Note any programmed projects that could have the potential to mitigate any freight need on the segment in Column H. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis, they can be entered in the right-most column (Column H).

Table 2 - Step 2 Example

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address needs or other relevant issues identified in previous reports)
1	5	29-34	Medium	None	None	Medium	
2	9	34-43	High	None	None	High	
3	17	43-60	None	None	None	None	
4	20	60-80	High	None	None	High	
5	24	80-104	Low	None	None	Low	
6	2.5	104-111	Medium	None	None	Medium	
7	20	111-131	High	None	None	High	
8	11	131-142	High	None	None	High	
9	6	142-149	High	None	None	High	
10	14	149-162	Low	None	None	Low	
11	14	162-176	Medium	None	None	Medium	
12	14	176-190	Medium	None	None	Medium	
13	12	190-202	High	None	Passing Lane at MP 190 - MP 195 (NB)	High	Adjustment to the Northbound Average TPTI to estimate the impact of the recently constructed passing lane showed no change in the Level of Need for this segment.

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab (Column D). The Step 3 sample template is illustrated in **Table 3** for the I-40 corridor.

The steps to compete Step 3 include:

Step 3.1

Input all roadway variable data that describe each segment (Columns E - M) into the appropriate columns. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.2

Input all traffic variables for each segment (Columns N - P) into the appropriate columns. The Buffer Index (Columns Q – R) will auto populate based on the TPTI and TTTI input in the Step 1 tab. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.3

Input any freight-related infrastructure (Column S) that currently exists on the corridor for each segment. The relevant infrastructure can include DMS locations, weigh stations, Ports of Entry (POE), rest areas, parking areas, and climbing lanes. Include the mileposts of the listed infrastructure. This data can be extracted from the most recent Highway Log and the 2015 Climbing and Passing Lane Prioritization Study.

Step 3.4

In the lower portion of Column E – Column M input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for the analysis period on ADOT's 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures (Column E)
- % Closures (No Reason) (Column F)
- % Incidents/Accidents (Column H)
- % Obstructions/Hazards (Column J)
- % Weather Related (Column L)

Step 3.5

In the lower portion of Column N/O, list the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. Examples of Non-Actionable conditions can include border patrol check points and other closures/restrictions not controlled by ADOT. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.6

Input any programmed and planned projects or issues that have been identified from previous documents or studies that are relevant to the Final Need (Column D). Sources for this data include the current Highway Log, the 2015 Climbing and Passing Lane Prioritization Study, and ADOT's 5-year construction program.

Step 3.7

Considering all information in Steps 1-3, identify the contributing factors to the Final Need (Column S). Potential contributing factors to freight performance needs include roadway vertical grade, number of lanes, traffic volume-to-capacity ratios, presence/lack of a climbing lanes, and road closures. Also identify higher than average percentages of one or more closure reasons on any given segment.

.

Table 3 - Step 3 Example

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables										Traffic Variables					Relevant Freight Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	Sustained Grades	% No Passing		Existing LOS	Future 2035 LOS	% Trucks	NB/EB Buffer Index (TPTI-TTTI)	SB/WB Buffer Index (TPTI-TTTI)	
1	0-11	11	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	D	36%	0.09	0.04	Dynamic Message Sign (DMS) at MP 8 (EB); Topock Port-of-Entry (POE) at MP 4;
2	11-43	32	Low	Interstate	Rural	Level	2	75	No	Divided	No	0%		A-C	A-C	29%	0.04	0.04	Haviland Rest Area at MP 23 (EB/WB)
3	43-55	12	Low	Interstate	Fringe Urban	Mountainous	2	75	No	Divided	Yes	0%		A-C	D	29%	0.11	0.06	DMS at MP 45 (EB)
4	55-74	19	None	Interstate	Rural	Rolling	2	75	Yes	Divided	No	0%		A-C	D	24%	0.12	0.09	DMS at MP 55 (WB); DMS at MP 69 (EB); Climbing Lane at MP 66-71 (WB)
5	74-80	6	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	D	24%	0.03	0.06	
6	80-98	18	Low	Interstate	Rural	Rolling	2	75	Yes	Divided	No	0%		A-C	A-C	25%	0.15	0.05	Climbing Lane at MP 88-90 (EB)
7	98-108	10	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	A-C	27%	0.04	0.04	
8	108-120	12	Low	Interstate	Rural	Mountainous	2	75	No	Divided	Yes	0%		A-C	D	28%	0.03	0.06	
9	120-143	23	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	D	24%	0.05	0.05	DMS at MP 124 (WB); Weigh Station (MP 131) closed
10	143-160	17	Low	Interstate	Rural	Mountainous	2	75	Yes	Divided	Yes	0%		A-C	D	17%	0.15	0.06	DMS at MP 144 (EB); DMS at MP 148 (WB); Truck Parking Area at MP 155 (WB); Climbing Lane at MP 153-156 (WB) and 153-156 (EB)
11	160-168	8	Low	Interstate	Rural	Mountainous	2	75	No	Divided	Yes	0%		A-C	D	15%	0.09	0.05	DMS at MP 168 (WB)
12	168-184	16	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	D	18%	0.03	0.03	Parks Rest Area at MP 182 (EB/WB) closed
13	184-190	6	Low	Interstate	Rural	Rolling	2	75	No	Divided	No	0%		A-C	D	19%	0.04	0.03	DMS at MP 184 (EB)
14	190-196	6	Low	Interstate	Urban	Mountainous	2	65-75	No	Divided	Yes	0%		A-C	A-C	26%	0.03	0.07	DMS at MP 198 (WB)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent									Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# of Closures	% Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
1	0-11	11	Low	14	1	7%	11	79%	0	0%	2	14%			N/A
2	11-43	32	Low	70	6	9%	31	44%	0.7	1%	32	46%			N/A
3	43-55	12	Low	37	0	0%	24	65%	1.11	3%	12	32%		Proposed Climbing Lane at MP 47-49 (EB) - Tier 2 Medium Priority	Bridge clearance is two inches short of standard clearance of 16 feet and no ramps exist
4	55-74	19	None	79	3	4%	46	58%	0	0%	30	38%			N/A
5	74-80	6	Low	66	6	9%	30	45%	0	0%	30	45%			Percentage of closures due to weather above statewide average (45% vs. 5%)
6	80-98	18	Low	191	17	9%	83	43%	0	0%	90	47%			Percentage of closures due to weather above statewide average (47% vs. 5%)
7	98-108	10	Low	98	10	10%	38	39%	0	0%	50	51%			Percentage of closures due to weather above statewide average (51% vs. 5%)
8	108-120	12	Low	117	12	10%	44	38%	0	0%	61	52%		Planned DMS at MP 120 (WB)	Bridge clearance is one inch short of standard clearance of 16 feet and no ramps exist Percentage of closures due to weather above statewide average (52% vs. 5%)
9	120-143	23	Low	186	22	12%	66	35%	0	0%	97	52%			Percentage of closures due to weather above statewide average (52% vs. 5%)
10	143-160	17	Low	189	30	16%	46	24%	11.34	6%	100	53%		Planned DMS at MP 160 (EB); Proposed Climbing Lane at MP 151-152 (EB) - Tier 2 Medium Priority; Proposed Climbing	Percentage of closures due to weather above statewide average (53% vs. 5%) Percentage of closures due to obstruction hazards above statewide average (6% vs.
11	160-168	8	Low	79	16	20%	6	8%	0.79	1%	56	71%		Proposed Climbing Lane at MP 162-163 (WB) - Tier 3 Low Priority	Percentage of closures due to weather above statewide average (71% vs. 5%) Percentage of undefined closures above statewide average (20% vs. 16%)
12	168-184	16	Low	139	32	23%	9	6%	32	23%	98	71%			Percentage of closures due to weather above statewide average (71% vs. 5%) Percentage of undefined closures above statewide average (23% vs. 16%)
13	184-190	6	Low	56	13	23%	11	20%	13	23%	32	57%		Proposed Climbing Lane at MP 188-190 (EB) - Tier 1 High Priority	Percentage of closures due to weather above statewide average (57% vs. 5%) Percentage of undefined closures above statewide average (23% vs. 16%)
14	190-196	6	Low	52	12	23%	10	19%	12	23%	30	58%		Proposed Climbing Lane at MP 191-193 (WB) - Tier 2 Medium Priority	Percentage of closures due to weather above statewide average (58% vs. 5%) Percentage of undefined closures above statewide average (23% vs. 16%)